POWER

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ELY C. HUTCHINSON, *Editor*

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Carelessness

WHAT a large proportion of human suffering and misery, of property loss and financial sacrifice, of impaired efficiency and hindrance of progress are caused by carelessness.

A catastrophe occurs and among the sufferers, perhaps not injured in person or means but condemned to a life of poignant remorse, is one whose carelessness brought it about.

If he had not done some thoughtless little thing, if he had done something which he was depended upon to do, all would have been well. Infliction to others would have been averted and he would have been spared years of self-reproach and agonizing regret.

Most carelessness does not result in spectacular calamity, but its aggregate in wasted time and material, in annoying interruption to the smooth progression of the day's work, in the creation of embarrassing situations and the disturbance of material relations is enormous.

What day passes in your own experience that would not be more productive, more satisfying, not so subject to more or less serious annoyances, if it were not impaired by your own carelessness or that of others?

Many a bright young fellow, qualified in other respects for a big rôle in business or industry, has blotted his record, forfeited the favorable attention of his superiors and hampered his chances of promotion, not because of errors of judgment or lack of ambition and intelligent application but because perhaps with his mind upon larger things, he failed in the careful oversight and checking of something for which he was held responsible.

Continual concentration and constant vigilance are difficult to maintain. Even Jove nods and all are subject to lapses. But thoroughness and accuracy, as well as carelessness and neglect, may be made habitual by practice; and he who lapses least will do himself the minimum of harm and be of the most value to others.

EDITORIALS

Another Forward Step In Welding Codes

WELDING took another forward step recently when the New York sections of of the A.S.M.E. and the American Welding Society joined hands to discuss the proposed code for the welding of unfired pressure vessels. Because of its importance the meeting is reported in some detail in this number.

Three major points stood out in the long discussion. First, it was clear that co-operation is better than ever before; manufacturers of welding equipment and supplies, fabricators of pressure vessels and the A.S.M.E. Boiler Code Committee are working shoulder to shoulder to perfect codes that will fully protect the public without throttling the legitimate expansion of welding.

Second, it was evident that a satisfactory code for unfired pressure vessels will become a reality in the near future.

Third, the committee itself pointed out that this code, once adopted, may form a safe foundation for the long-sought code for welded boiler drums.

Such progress has not been made without effort. Only by much experience have welding interests as a group learned that co-operation is more potent than the old-style "free for all," that individual interests are best promoted by unified action that considers all factors, including public safety.

That the code committee, which has the final decision on all code matters, is eager to accelerate constructive action, was evident at the meeting. The committee merely insisted—and rightly so—that welding proponents shall agree on what is safe and that their proposals shall amply protect the user.

The proposed code seems to provide such assurance. Designed as a "target to shoot at," it deliberately incorporated all tests that *seemed* important. The next step is simplification. Suggestions made at the meeting may lead to the elimination of certain tests, such as the notched-bar impact test, as needless burdens. It also seems possible that while stress relief by general heating may be retained as a requirement for the highest-grade vessels it may be eliminated in the case of vessels for less severe service.

Other changes will doubtless be made to retain the full value of the present proposed code, without imposing any unnecessary expense on the makers or users of unfired pressure vessels. Perhaps the most important will be the setting up of several classifications of pressure vessels, graded as to severity of service. The Boiler Code Committee, with the continued co-operation of the American Welding Society, is actively engaged in reducing the vast amount of material now at hand to code form, and in sixty or ninety days a revised code proposal should be ready for general distribution.

Plant Efficiency Without Surplus Capacity

COLONEL ARTHUR WOODS' message in the Jan. 20 number of *Power* emphasized the desirability of "sound plant modernization and lines of improvement which add to efficiency without producing surplus capacity."

Whether or not it is agreed that a part or all of the passing depression is the result of overproduction, the soundness of the Colonel's suggestion is patent.

In a number of instances the ability to produce has exceeded the present market demand. The consequence is "surplus capacity." Another result is reduced prices. So, then, there is the combined effect of surplus capacity and reduced prices, a rather disconcerting couple.

But there are ways to conquer the combination, and Colonel Woods has aptly phrased one of them, "add to efficiency without producing surplus capacity." This should tell industry to reduce the cost of its products by finding ways—not to produce more—but to perfect pro-

cedure so as to produce an equal or better quality for less money. This accomplished, a hitherto untapped market will be opened and consumers never before on the list will add their quotas to the return of normalcy.

The responsibility of power producers, both industrial and public utility, is very clear in the whole program. Power enters into the cost of practically every commodity. Without it little of the present civilization would exist. What happens to power, therefore, is a clear index of what may be expected in other directions.

It requires no imagination, consequently, to recognize in Colonel Woods' message a direct appeal to power producers to reduce power cost by "adding to efficiency of operation without producing surplus capacity."

Cheap Diesel Fuels Are Available

THE praiseworthy steps taken by a research committee of the American Society of Mechanical Engineers to study the diesel fuel situation with a view to the formulation of a standard fuel specification have resulted in some unjustified uneasiness as to the diesel fuel supply. Diesel fuel oil is obtainable at low prices, and the research mentioned was not initiated by any fear of a market shortage. The background is as follows:

As long as mid-continental, Pennsylvania and Pacific coast crude oil is being refined a satisfactory diesel fuel is available, for these crudes yield a fuel oil that shows excellent performance in any oil engine. Consequently, west of the Allegheny Mountains a satisfactory fuel can be guaranteed by the refiners.

It happens that many refiners make use of crude oils from several fields, which are mixed in the refining process, the fuel oil being a composite one. The characteristics of this fuel oil cannot always be predicted, so that occasionally a shipment is received by an engine user that will not burn satisfactorily. To reduce this hazard users set up over-rigid specifications to meet which the refiner must make a run of oil from a single field. Like all special things, this oil costs more than the standard product.

The problem, then, is to find out what makes a fuel oil unsuited for diesels, and with this information to prescribe refining methods that will insure that these limitations are not exceeded. This should lead to lower prices and standardized results.

In some respects the situation is a local one, as the variation in fuel oil characteristics is in evidence chiefly along the Atlantic Seaboard, where much Venezuelan crude is refined.

The A.S.M.E. committee is carrying out extensive tests, and there are indications that from this research will evolve a standard diesel fuel the price of which will be below the present prices of satisfactory fuels. Diesel fuels are cheap and will probably be cheaper.

Why House Coal Bunkers?

EVERY once in a while some engineer suggests that boilers be installed in the open to save building cost. As a matter of fact, many boilers in tropical districts are virtually in the open. In the oil fields the practice is common, and a large high-pressure central station is now being built in California which will embody this feature. In northern latitudes there appear to be operating advantages in having the boiler plant completely sheltered. Yet one is justified in questioning whether all boiler house equipment, and particularly the coal bunkers, need be inside.

The coal bunker is generally placed high above the stokers or pulverizers in order to permit the boiler tubes to be withdrawn. Heavy steelwork must be provided for its support, and this, with the extra height of boiler house required, represents a substantial item of cost. Coal bunkers in a boiler room also produce lighting problems. In winter, when filled with frozen or very cold coal, they may cause fog at the top of the boiler room, and the condensation results in annoying drips.

One new station has coal storage "silos" outside the boiler room. These offer certain advantages and are undoubtedly cheaper than inside bunkers. The only objection that has been advanced against their use in northern latitudes is the possibility of arching if crushed frozen coal be put in on a very cold day and a thaw follows.

Another recently completed station stores the coal in a pile adjacent to the boiler plant. A tunnel running under the pile is provided with gates and conveyors to deliver the coal to the pulverizers. Coal may be delivered to the pile by a belt trimmer or moved to the gates by a drag scraper.

The first cost of some such arrangement is low; its simplicity and ease of operation are apparent. Whether there will be a dust nuisance in summer, if dry coal is received and the trimmer is used, or whether a long cold rain in winter followed by severe freezing will require emergency measures to break up the pile, are potential problems.

Experience will show whether outside coal bunkers are fully justified. The present trend appears to be toward their increased use.

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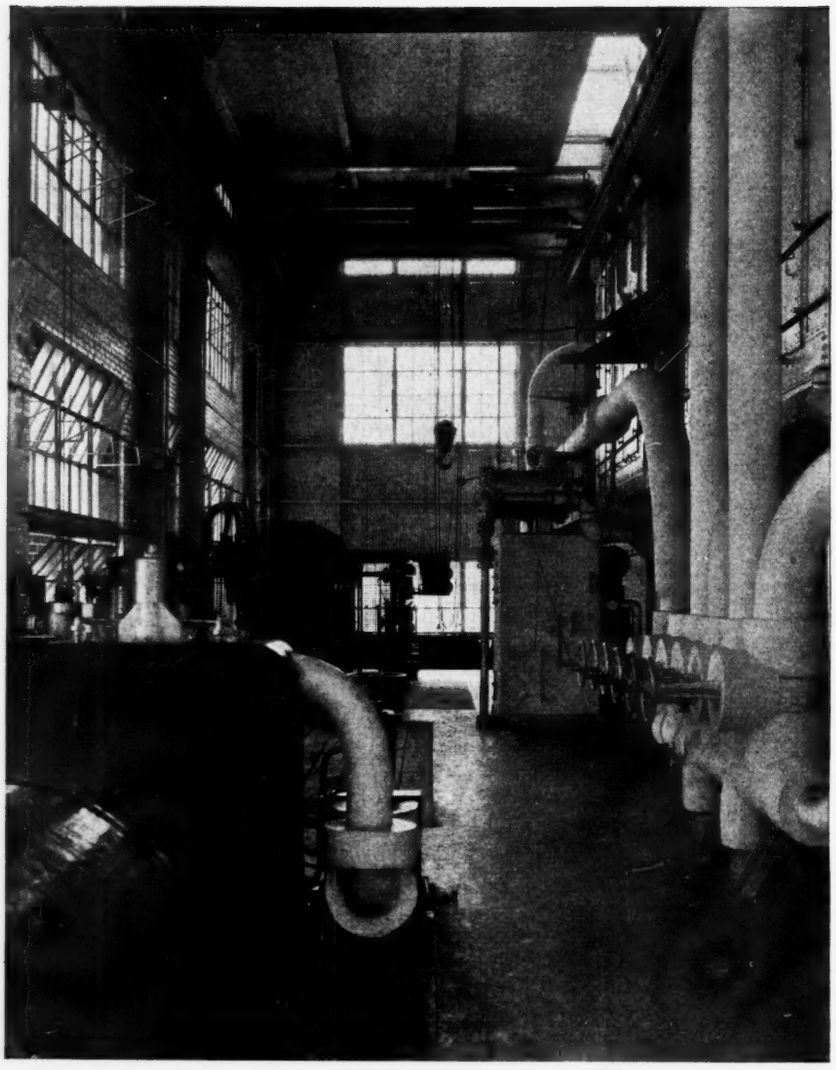
POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason



Process Steam F

Operation of the new plant in parallel with the American Gas and Electric Company's system greatly facilitates proper heat balance

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There is no division wall between the boiler and turbine rooms of the Tennessee Eastman power plant

THE Tennessee Eastman Corporation's plant at Kingsport, Tenn., originally built to assure a dependable supply of methanol and acetone to the Rochester plant of the Eastman Kodak Company, now produces acetic acid and acetic anhydride in large quantities, in addition to hardwood lumber, charcoal in various forms, pitch, creosote oils, several commercial grades of methanol and other byproducts of wood distillation.

Acetic acid and acetic anhydride, plus cotton linters, make cellulose acetate, the basic substance of safety films, a product of the Eastman Kodak Company used for home motion pictures and X-ray photography. Until this year the production of cellulose acetate by the Eastman Kodak Company had been at its chemical plant in Rochester, N. Y.

The steady rise of cellulose acetate as an important photographic raw material made it apparent that economies could be effected by treating cotton linters from western Tennessee with the two acetic chemical products of Tennessee Eastman at Kingsport and shipping cellulose acetate, rather than its ingredients, to Rochester. Consequently, a modern plant for the manufacture of cellulose acetate, about a thousand feet removed from the existing wood chemical plant, was constructed and put into operation early this year.

At the same time a new power house was built which supplies steam and electric power to the old chemical plant as well as to the new cellulose acetate plant and other chemical processes. Three new boilers replace the six hand-fired boilers of the old plant, and operate a new 1,500-kw. non-condensing turbine-generator as well as the 500-kw. turbine-generator in the old plant. Provision is made for the addition of a 3,000-kw. generator.

A feature of the new power house is the absence of a division wall between the boiler room and the turbine room, which resulted in a lower initial cost and a more efficient and compact plant. The design and location of all coal-handling equipment was carried out in such a manner as to minimize dust from that source. The coal bunkers, elevators and rigid-type coal chutes are sealed dust-tight, and the ash-removal equipment is similarly constructed.

Elimination of the dividing wall gives easy access to all piping and equipment. Experience from six months' operation has shown that the power house can be kept just as clean as if the dividing wall had been built. There are no dark spaces behind the boilers or in the aisles between, as is evidenced by the photographs. White enamel paint was used throughout except on machinery and boiler settings, where other suitable paints and lacquers were used.

The new 1,500-kw. turbine-generator and the old

Furnishes Power for Tennessee Eastman Plant

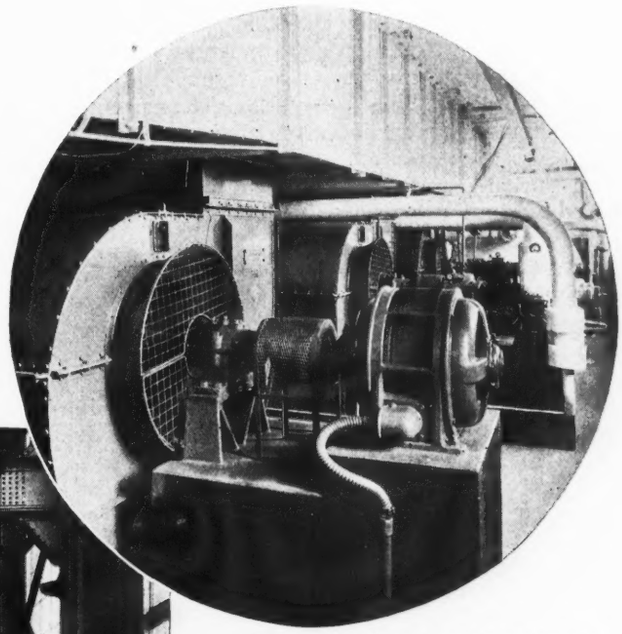
By GEORGE W. ANDERSON
Superintendent
Tennessee Eastman Corp.

500-kw. machine operate in parallel with the system of the American Gas & Electric Company. Both of these units are provided with back-pressure governors. The new power plant, by means of the turbines and reducing valves, reduces the 450-lb. boiler steam pressure to 90 lb. and 10 lb. for process use.

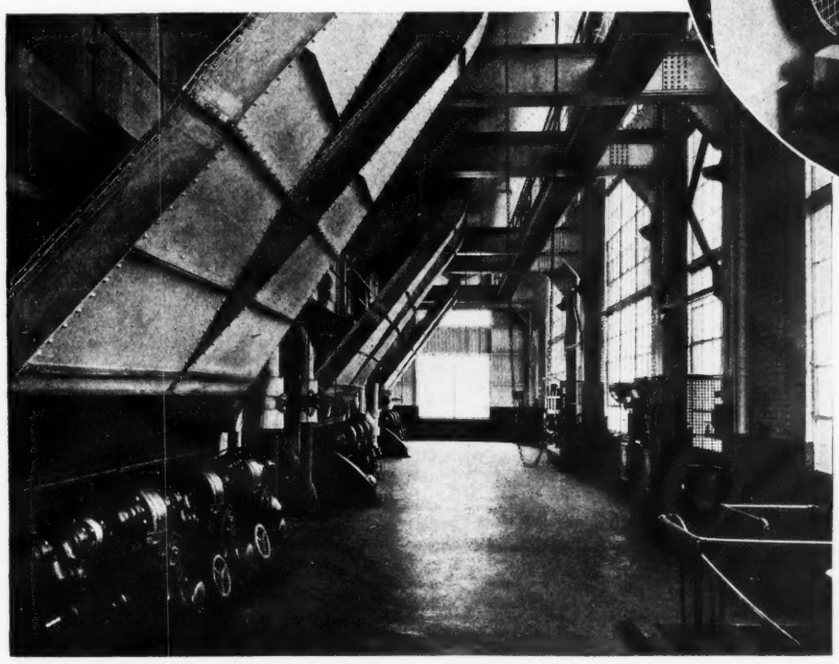
The auxiliaries in the new power plant are normally steam driven, from the 90-lb. system, exhausting into the 10-lb. mains. Motor-driven units are also provided for flexible operation under varying process steam demands. A large part of the 90-lb. steam exhausted from the 1,500-kw. turbine may be passed through the 500-kw. turbine in the old plant, and returned through a 10-lb. steam line when conditions require. An overhead steel structure carries the two 10-in. steam lines and a 4-in. condensate return between the plants.

Since the exhaust from the 1,500-kw. turbine may not be sufficient under all load conditions to provide the 90 lb. steam demand, a 450- to 90-lb. reducing valve and a desuperheater are provided. The 90-lb. piping is protected from excess pressure by a set of safety valves. To permit repair of these without shutting down the plant, a gate valve is installed ahead of each safety and is normally locked open. The 10-lb. piping system is similarly protected.

The three boilers in the new power plant are built for 450-lb. working pressure and 125 deg. superheat and each contains 8,695 sq.ft. of heating surface, with 54-in.-diameter cross drums. The boilers are sectional-header type, 24 sections wide, 15 tubes high and 20 ft. long. Plant processes demand that a minimum of soot and cinders leave the stack.



Two of the three forced-draft fans are driven by turbines designed for 90 lb. steam and exhausting at 10 pounds



Ample windows and white enamel paint give boiler room a well-lighted appearance

The boilers are fired under the downcomer, or low, end, and have a horizontal baffle over the stoker. The pocket under the third pass, between the front headers and the horizontal baffle, where dust and cinders collect, is provided with a hopper and 6-in. screw conveyor extending outside the

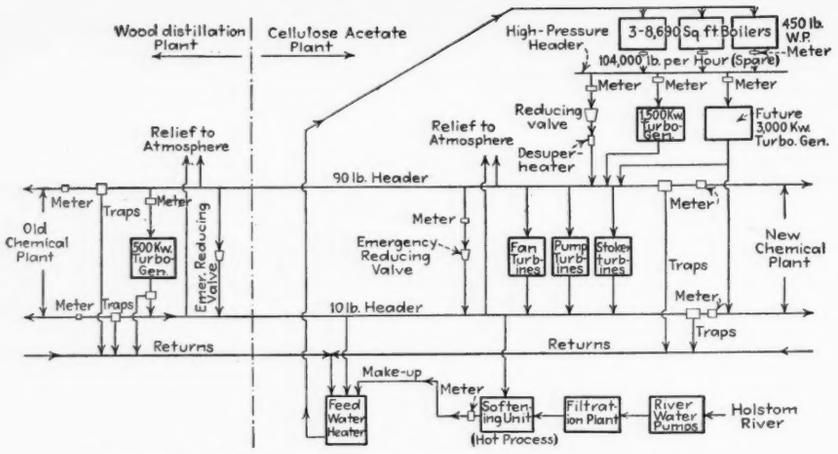


Diagram of steam distribution to processes, and interconnections between old and new turbines

setting. The dust and cinders are sluiced to the basement.

The furnaces, of firebrick throughout, 14 ft. 2½ in. wide and 12 ft. 1½ in. deep, have a fuel area of 190.26 sq.ft. and are designed to burn a nut and slack grade of coal with a high B.t.u. value and low ash content, but with a low-fusion ash. Air-cooled silicon carbide blocks are used in the front, side and bridge walls. A side-wall header course, projecting 1½ in., also helps to minimize slag adherence. Air at room temperature is circulated in the bridge wall and then passed through the side walls into the furnace. The front walls are perforated, and air is admitted to the fireboxes above the main stoker rams.

All furnace walls are provided with asbestos-rope-packed vertical expansion joints, approximately 36 in. apart, extending the full height of the setting. Bridge-wall expansion is cared for in a similar manner, and in addition the bridge walls are separated from their concrete foundation by a thin layer of white silica sand to permit free expansion.

Under each boiler an eight-retort underfeed, dual-drive, three-section stoker with a power agitator and dump grate provides utmost flexibility for coal feeding. Three gearboxes are provided, two boxes each driving three retorts, while the third box drives the two center retorts. The stoker drive comprises a four-speed semi-inclosed 440-volt motor and a 5-hp. turbine-gearbox unit. The turbine drive operates at a nozzle pressure of 90 lb., with 25 deg. superheat, and exhausts into the 10-lb. system. The ash dump grates are operated from the main high-pressure header.

Three forced-draft fans, each with a capacity of 30,000 c.f.m. at 5 in., are of the double-inlet type with full housing. One fan is connected directly to a 40-hp. 1,200-r.p.m. squirrel-cage motor. The other two fans are each driven by a 40-hp. turbine also on the 90-lb. steam system. The high-pressure steam manifold is conveniently placed for valve operation at shoulder height on the turbine room floor.

The pump house obtains its water supply from the Holston River and has four centrifugal pumps with a capacity of 12,500 g.p.m. at 130 ft. total head. In addition, the pump house contains two 1,000-g.p.m., 130-lb.-pressure fire pumps, one with a 100-hp., 2,100-r.p.m. turbine drive with constant speed and emergency governor. These two pumps and the city water supply afford fire protection to both plants through a fire-loop header.

It is imperative that a continuous supply of mill-service water be furnished, since a shutdown of only a few minutes would involve production losses. For this reason a 200-hp. synchronous motor, driving a 5,000-g.p.m. pump, is provided with a full automatic starter. After any momentary failure of current the pump is automatically brought back into service. A 16-in. foot valve on the pump suction provides for priming.

The boiler feed-water softener is 200 ft. from the new power house. The entire unit, a hot-process, lime-soda system, including settling tank, heater, chemical tank, electrical proportioner, chemical pumps, pressure filters and all piping valves, requires a floor space of 40x20 ft.

PIPING SCHEDULE

	Kind of Pipe	Work. Pr.	Test Pr.	Joints	Gaskets	Fittings	Bolts
		Lb. Sq. In.					
High-pressure steam	Open hearth seamless tubing	450	1,000	Square-lap Van Stone flanges phonographic facing	Smooth Monel metal	Electric steel castings	Chrome-alloy steel studs
Feed water	Open hearth seamless tubing	480	1,000				
Boiler blowoff	Open-hearth lap-welded Extra-strong	450	800				
8-in. steam manifold	Forged-steel one piece	400	1,000				
90-lb. header lines	Standard lap-welded	90	200	Low-hub Van Stone flanges plain face	⅛ in. corrug. copper, asbestos filled	C. I.	Commercial bolts
Process steam (inter-plant)	Standard lap-welded double-random lengths	90 10	200	Sleeve acetylene welded. Also 250 lb. low-hub Van Stone, rolled steel flanges		C. I.	
10-lb. header lines	Standard lap-welded double-random lengths	10	200	C.I. flanges plain face		C. I.	
Condensate return (inter-plant)	Standard wrought iron	50	200	Sleeve acetylene welded. Also 125 lb. C. I. flanges		C. I.	
Hot and cold service water	Standard lap-welded	50	200	Below 4 in. standard screw, C. I.; 4 in. and over-standard flanged., plain face C. I. flanges and fitg's		C. I.	
High-press drip	Ex. heavy lap-welded	450	1,000	Majority screwed, welds between header and valves	Smooth Monel metal	Electric steel	Chrome-alloy steel studs

Principal Equipment Data

Boilers, 3, 450 lb. W.P., 8,695-sq.ft., cross-drum, sectional-header, reversed-type setting, Hedges-Walsh Weidner (Combustion Engrg. Corp.)
Superheaters, 3, superheaters to give a steam temperature of 575 deg. F., 30 2-in. elements.....Foster-Wheeler Corp.
Stokers, 3, 8-retort, dual-drive, underfeed type in three sections, Westinghouse Eletric & Mfg. Co.
Stoker turbines, 3, 5-hp., 600-6,000 r.p.m., 90 lb. pressure at inlet nozzle, 10 lb. exhaust.....Westinghouse Electric & Mfg. Co.
Stoker motors, 3, semi-inclosed, 440 volts, 4 speeds; drum controllers, ...Westinghouse Electric & Mfg. Co.
Boiler refractories, ...Harbison-Walker Refractories Co.
Settings by .....Rust Engrg. Co.
Bridge-wall facing, B. & W. No. 80.....Babcock & Wilcox Co.
Air-cooled furnace walls, 3, silicon carbide, air-cooled blocks in four walls .....Bernitz Furnace Appliance Co.
Boiler water columns, 3, 600-lb. floatless, inclined flat-glass type with Mercoid alarm.....Yarnall-Waring Co.
Water column illuminators, 3, louver type .....National Co.
Turbine-generator, 1,875-kva., 3,600-r.p.m., 480-volt, 3-phase, 60-cycle; direct-connected exciter; 400 lb., 125 deg. F. superheat nozzle pressure, 90 lb., 25 deg. superheat exhaust Westinghouse Electric & Mfg. Co.
One 16-kw., 125-volt, 128 amp., 3,600-r.p.m. direct-connected, shunt-wound exciter .....Westinghouse Electric & Mfg. Co.
Generator oil cooler, 1, tubular, requires 60 g.p.m. 80 deg. water, Andale Co.
One, U-fin, 1,063 sq.ft. surface.....Griscom-Russell Co.
One, 5¼ x 4¾ x 5 in. duplex steam pump, Worthington Pump & Mach. Corp.
Ash handling equipment, 3 sets, 40 lb., hydraulically operated gates; three gates per hopper, 24-hr. capacity at 233 per cent rating; equipped with quenchers .....R. H. Beaumont Co.
Coal handling equipment, maximum capacity 75 ton per hour; hopper, feeder, crusher, elevator, conveyor, tripper, Jeffrey Mfg. Co.
Motors for coal handling equipment, 3; 1, 30-hp., crusher and feeder; 1, 15-hp., elevator; 1, 5-hp., conveyor..General Elec. Co.
Coal bin, 20x20x85 ft. long parabolic-type, 550-ton capacity, Virginia Bridge & Iron Co.
Overhead traveling crane, 15-ton, hand-power; 20-ft. span, 30-ft. lift .....Whiting Corp.
Feed-water heater, deaerating, capacity 170,000 lb. per hr.; open type, 10 lb. pressure, 220 deg. F. water to boilers.Cochrane Corp.
Boiler-feed pumps, 3, 250-g.p.m., 1,130-ft. head, 3,500-r.p.m., 6-stage; 3-in. suction, 2½-in. discharge....Allis-Chalmers Mfg. Co.
Boiler-feed pump motor, induction, 125 hp., 3,500-r.p.m., squirrel-cage type .....Allis-Chalmers Mfg. Co.
Boiler-feed-pump turbines, 2, 120-hp., 3,500-r.p.m. Allis-Chalmers Mfg. Co.
Forced-draft fans, 3, Turbovane, size 90.....B. F. Sturtevant Co.
Fan motor, 40-hp., 1,200-r.p.m., 440-volt, squirrel-cage, General Electric Co.
Fan turbines, 2, 40-hp., 3,260-r.p.m., 90 lb. inlet, 10 lb. exhaust, Terry Steam Turbine Co.
Desuperheater, 10-in. spray type, cast-steel, nickel-bronze nozzles, equipped with Arca water-operated temperature controller, Schutte & Koerting Co.
Soot blowers, 3, seven 2-in. automatic valve-in-head units per boiler .....Diamond Power Specialty Corp.
Steam pressure reducing valves, 2, one 6-in. cast-steel 400 to 90 lb.; one 8-in. cast-iron, 90 to 10 lb.....Locke Regulator Co.
Relief and bypass valves, 4, angle, spring-type, 105 lb., 6 in. dia., Crosby Steam Gage & Valve Co.
Boiler safety valves, 9, two 4-in. safety valves on each drum; one 2½-in. safety valve on each superheater, Consolidated Ashcroft Hancock Co.
Blowoff valves, 3, 2½-in. dia. sets, 600 lb.....Yarnall-Waring Co.
Water-softening equipment, hot-process, lime-soda softener with capacity of 15,700 gal. per hour.....Permutit Co.
Oil circuit breakers, 12, 500-3,000 amp., solenoid- and motor-operated, remotely controlled.....General Elec. Co.
Steam-flow meters, mechanical type.....Bailey Meter Co.
Steam flow meters, electrical type.....Republic Flow Meters Co.
Boiler meters, with flue gas temperature recorder, Bailey Meter Co.
Boiler pressure gages.....Consolidated Ashcroft Hancock Co.
Master steam gages, pressure and temperature recorders and indicators .....Foxboro Co.
Water-level indicator.....Liquidometer Corp.
Boiler-feed-water meter .....Builders Iron Foundry
Structural steel .....Virginia Bridge Co.
Stack, brick, 12 ft. dia. x 200 ft. high.....Rust Engrg. Co.
Stack connections .....Connery & Co.
High-pressure valves .....Crane Co., Walworth Co. and Chapman Valve Mfg. Co.
Heat insulation, Johns-Manville materials..W. Reid Hayden, Inc.
Piping .....Grinnell Co.
Low-pressure valves .....Crane Co.
Storage battery .....Electric Storage Battery Co.
Circuit breaks for station auxiliaries...I.T.E. Circuit Breaker Co.
Main switchboard, panels, instruments, buses, switches and grills .....General Elec. Co.
Transformers, power, lighting, switchboard.....General Elec. Co.

and headroom of 38 ft. A 6-in. steam line from the new plant supplies 10-lb. steam to this unit, which has a capacity of 15,700 gal. per hour.

About 101 lb. of hydrated lime and 65 lb. of soda ash per million pounds of water are required to hold the hardness of effluent to an average of 24 p.p.m., or 1.40 gr. per gallon as calcium carbonate. Holston River water has the following average analysis:

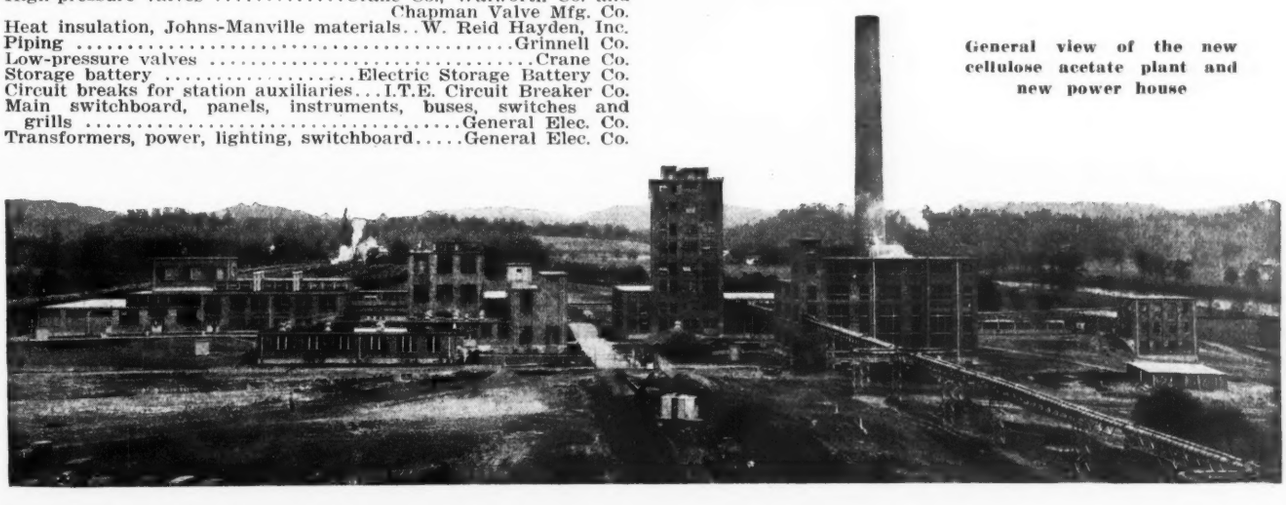
	Calculated As	P.p.m.
Total hardness	$CaCO_3$	74
Calcium hardness	$CaCO_3$	54
Magnesium hardness	$CaCO_3$	20
Alkalinity	$CaCO_3$	76
Free CO_2	CO_2	5
Chlorides	Cl	6
Sulphates	SO_3	12
Iron	Fe	0.7

A variable-speed phosphate feeder is located in the treated-water line leading to the power house. The softened feed water is pumped to a 3,400-gal., high-level surge tank on the power house roof. Filtered river water is also used in the turbine air and oil coolers and the washroom, and it supplies the boilers in emergency. The high-level surge tank supplies a deaërating heater on the turbine room floor level which has a capacity of 170,000 lb. per hour. In the turbine room basement are three 6-stage boiler feed pumps equipped with excess-pressure regulators. They are each of 250 g.p.m. capacity at a total head of 1,130 ft. Two are driven by turbines at 90 lb. steam pressure and the third by a 120-hp. motor.

There are four sources of feed water, and any or all equipment can be bypassed in emergencies. All overflows drain into two 7,150-gal. insulated surge tanks in the basement. Either tank will hold the contents of one of the boilers when it is emptied for cleaning or repairs, thus saving the treated hot water. A 200-g.p.m. centrifugal pump located below the two surge tanks lifts the condensate to the 3,400-gal. tank on the roof. All overflows to the sewer have sight glasses or funnels.

A conductivity recorder, in connection with a special 4-in., three-port, two-way motor-operated valve inserted in the 4-in. condensate return line, controls the purity of all drip returns. Any contamination caused by process equipment is brought to the attention of the operator by an electrical alarm, and at the same time the contents of the line are automatically dumped to the sewer.

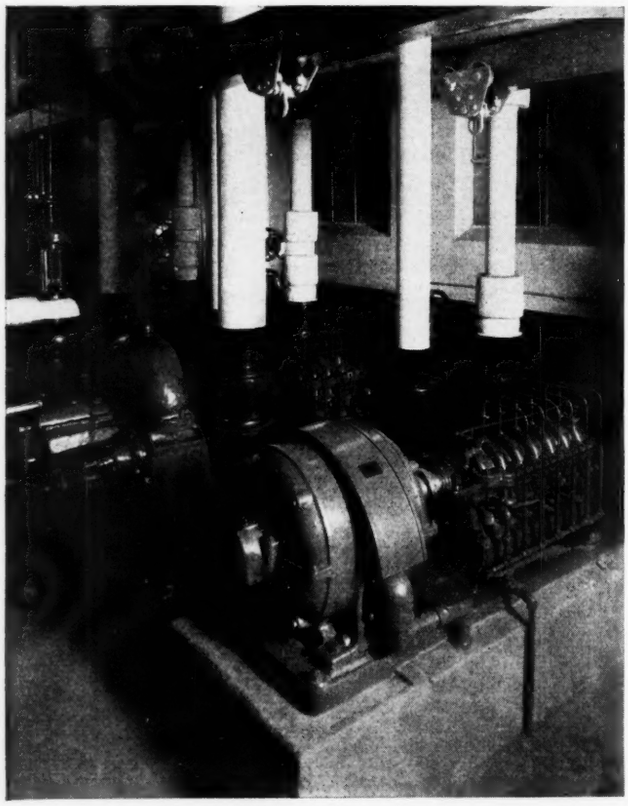
Incoming coal is weighed on plant track scales and delivered to the track hopper, covered with an 8-in. square-mesh bar grating. An apron feeder discharges into a 30 by 30-in. single-roll crusher. Both feeder and crusher are driven by a 30-hp. motor. A 72-ft. continuous bucket elevator feeds an 18-in. trough belt con-



General view of the new cellulose acetate plant and new power house

veyor over the 550-ton storage bunker, holding about five days' supply. Coal goes to each boiler through two dustproof spreaders. The coal-handling apparatus, at present, will handle 50 tons per hour, but with minor changes a capacity of 75 tons per hour can be obtained.

The electric substation is located at some distance from the power house. There are two 22-kv. incoming utility power lines that feed through a 1,000-kva. bank of transformers to 440-volt substation buses. Underground cables connect the substation buses with the 500-kw. turbine buses in the old power house. Underground cables also connect the 500-kw. turbine buses with the new power house switchboard. The plant power lines, therefore, have three sources of supply. In emergencies, such



The three six-stage boiler feed pumps are located in the turbine room basement

as electrical storms, it is possible to separate and to supply independently certain departments to prevent even a momentary shutdown. The main power tie-line cables are of sufficient size to carry either plant in case either turbine is shut down. The tie-line cables, the direct-current control cable from a storage battery in the new power house to the remote-controlled apparatus in the other two stations, and the 30-conductor control and signal cable are of armored, underground type.

Steam-flow-meter nozzles are at strategic points in the piping, including the 500-kw. turbine exhaust, with recorders or remote repeaters on the power house panel. A wattmeter, with a Selsyn transmitter, in the substation, operates a zero-center indicating wattmeter on the power house panel and indicates the flow of current to or from the utility. With the aid of this instrument and the flow meters the operator is able to picture the entire steam and electric load conditions.

The power house was designed and erection supervised by Baker & Spencer, Incorporated, engineers, of New York City. The general contract was executed by the Gauger-Korsmo Construction Company, Memphis, Tenn.

Ashes—an Asset?

By K. RANKIN

HANDLING ash is a problem as old as the burning of coal. It is so old that most plants have ceased to look upon it as a problem—or an opportunity—and accept it as an inherently necessary evil that goes with the burning of coal. Except for endeavoring to buy coal with a low ash content, the ash receives little attention. Frequently it is necessary to pay someone to cart it away. In other cases, it can be dumped outside the plant and is taken away free of charge, depending upon the time of year, the ease with which the ash may be removed, and the status of railroad construction, sidewalk construction and similar undertakings. In fewer instances the ashes are sold.

If properly "merchandised" it is possible that power plant cinders of the proper characteristics could ultimately demand a premium because the demand exceeded the supply, to the advantage of the buyer of the coal, in that he would save the sale price of his cinders.

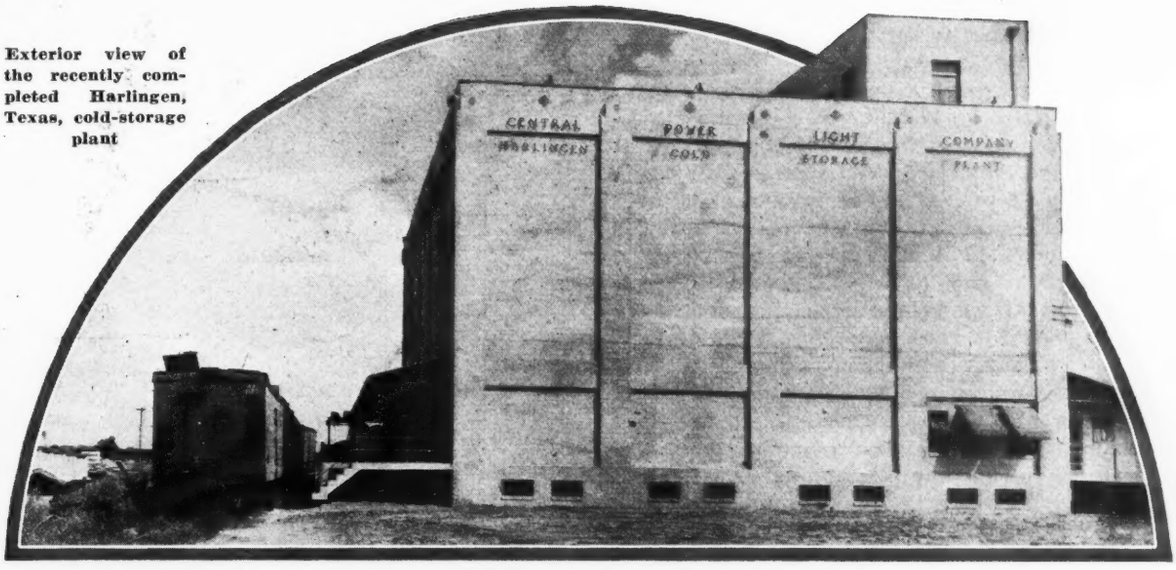
When the advantages of cinder concrete for fireproof construction of flooring and similar applications is better appreciated, in certain localities, ashes or cinders will become an asset. The largest users of coal may then be able to charge a dollar per cubic yard for their cinders instead of having to pay to have them removed. Moreover, when cinder concrete is used more generally for fireproofing flooring of large buildings, etc., a very real saving will be obtained in the cost of construction. It is understood that one large central station company in the Middle West is under contract to furnish all the cinders from one of its plants to a manufacturer of cinder concrete. It has been estimated that Chicago, alone, could use 4,000,000 cu.yd. of cinders per year for cinder concrete and an additional 500,000 cu.yd. for the building of cinder-concrete blocks. This corresponds to the consumption of approximately 35,000,000 tons of coal per year. Chicago's industrial plants use more than that.

A fact not generally realized is that New York City has employed cinder concrete for floor construction for many years. The Chase National Bank Building, Chrysler Building, Pennsylvania Station, and the new Empire State Building employ cinder concrete for fireproof floor construction. It has been claimed that in the construction of reinforced concrete skyscrapers a saving of 10c. per square foot can be obtained by its use.

If it becomes possible for the buyer of coal for power plant use to sell his cinders instead of having to pay to have them hauled away, the salability of cinders, representing a saving of from 25 to 50 cents a ton, is as important as striving for high CO_2 or any other fuel-saving factor.

The conservatism of some architects and many civic bodies; the hostility of competitive building materials; and lack of co-operation and unified, aggressive effort upon the part of the coal industry and the users of coal are the obstacles that must be overcome.

The writer does not contend that ash or cinders are a universal asset, but presents the foregoing observations in the hope of awakening a realization among the larger sellers and users of coal, builders and allied interests in the larger industrial centers that cinders and ash may be converted more generally from a costly nuisance to a profitable product.



Exterior view of the recently completed Harlingen, Texas, cold-storage plant

Cold-Storage Plant for City of 12,000

The new cold storage plant at Harlingen, Texas, is the forerunner of a new trend in cold storage. In the future the small town will enjoy all the facilities of food preservation possessed by the large cities, thereby lowering the cost of fresh food and allowing storage at the source

By E. A. BRANDT

Assistant to Vice-President, Middle West Utilities Co.

HARLINGEN, TEXAS, has just witnessed the initial operation of a modern, general cold-storage plant operated by the Central Power & Light Company. The fact that a new cold-storage plant is being placed in operation is not in itself unique at this time. Many have been constructed in the past few years in the large cities of the country. The unusual feature in connection with the Harlingen storage is that such a complete service unit should be placed in a city of twelve thousand people.

It has been the policy of the Central Power & Light Company, and the whole Middle West Utilities Company system, of which it is a member, to bring metropolitan utility service to the smaller cities and those communities situated at a distance from metropolitan areas. The Harlingen cold-storage plant is an example of this general policy.

Were it not possible to hold many perishable products from the time of their peak production, the producer would be forced to throw his wares upon a saturated market. The return to the producer would then be correspondingly low. Meanwhile the consumer would receive the benefits of the low prices, but for a short period only. Later scarcity would send prices to a high level and the consumption would fall off accordingly. Total consumption would then be comparatively small. It is easy to see, therefore, that steady, year-round consumption works to the advantage of everyone. This fact assures a stable, large-volume market for the producer. In the words of the power man, the load factor is increased and producer and consumer are both benefited thereby.

The foregoing is a brief outline of the storage function in the community. It is a statement of some of the advantages which will accrue to both producer and consumer in the Texas Rio Grande Valley through the construction of the Harlingen storage plant.

Situation with respect to transportation facilities is a prime consideration in the location of cold storage. The Harlingen plant has a railroad siding the full length of the building, connecting directly, and at short distance to both of the railroads serving the territory. Thus the location provides good, quick switching facilities that expedite the handling of commodities into or out of storage.

As water transportation continues to hold increasing interest and importance in the nation's plans for marketing, the storage will no doubt hold products that will be sent out through convenient Gulf ports now available. Plans also point to a new port to be constructed soon at

nearby Point Isabel which will be convenient to truck transportation from the storage plant.

Storage is provided on four floors. The basement, which houses the machine room in one corner, has a large, light open space for handling, packing and inspection. This working space embraces half of the basement floor area and is uninsulated at the present time. A portion will be used for dry storage, although columns are set out from the wall to provide for insulation in the future if that proves advisable. In one corner of this space a banana chute leads down from the rail-side platform. A quarter of the basement plan provides three banana rooms, one for ripening and two for storage. The upper floors afford complete cold-storage facilities of the latest type laid out in workable units.

The first floor plan provides office space overlooking the driveway platform. Meat tracks running the length of this platform and the car platform connect through the vestibule and have branches into the three first-floor rooms now equipped for meat storage. The remaining half of this floor is divided into four rooms for general storage.

On the second floor two large rooms and one small room provide for the storage of general goods. The design makes it easily possible to place partitions where desired to divide the space into units suitable for those who engage them. The top, or third floor, has five freezer rooms on one side of the center vestibule. The other half of the floor has one large cold storage room and one small room provided for fur storage service in the future. The larger room is designed for convenient conversion into three additional freezer rooms should this prove advisable.

Of reinforced concrete construction, the building is 90x70 ft. over-all, with covered platforms the full length of the two 90-ft. sides.

Outstanding features of the construction are the floating slab foundation, which replaced the conventional design owing to soil conditions. In the sub-grade concrete trap rock was used for aggregate to replace the usual gravel and provide a denser mix to aid waterproofing, which was supplemented on the exterior by a waterproof membrane before backfilling. The columns and floors were poured first and the outside walls added later.

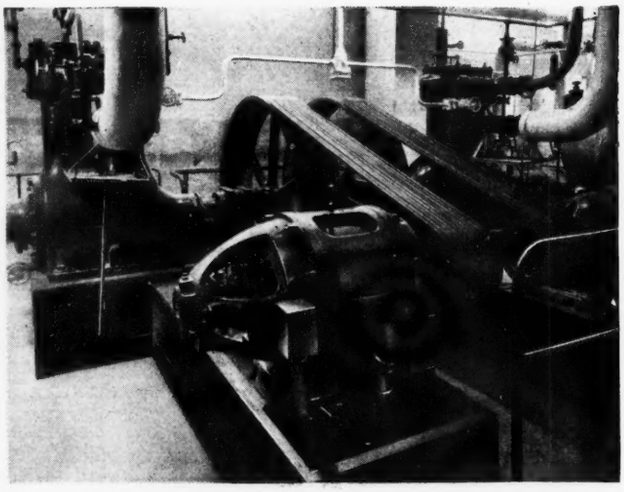


Fig. 2—Ammonia compressors are driven by slip-ring motors through V-belts

Outside walls carry 5 in. of corkboard. Floors and partitions of the cold-storage sections are insulated with 4 in. of corkboard. The freezer walls and the roof have 8 in. of corkboard, and the freezer floors 7 inches.

Mechanical equipment consists of ammonia compressors installed in two $9\frac{1}{2}$x$9\frac{1}{2}$-in. units operating at 250 r.p.m. to give a rating of 39.6 tons of refrigeration each. The compressors are driven through V-belts by 75-hp. slip-ring motors. Condensers are in two units, 30 in.x14 ft. long, horizontal, multi-pass, with 587 sq.ft. of exchange surface each. These are mounted side by side above two horizontal multi-pass brine coolers of the same size and exchange surface as the condensers. A vertical accumulator with a low side gage glass is placed between the two coolers, which are mounted above floor level on concrete piers. The accumulator is equipped with a float control of Gay design which maintains constant liquid level in the accumulator and at the same time keeps a liquid seal on the receiver. This action maintains the proper quantity of liquid in the coolers at all times irrespective of the load.

The refrigerating equipment may be operated either automatically or manually. Under automatic operation the temperature of the brine operates to start the water-circulating pumps. The pressure of the water passing through the condensers and over the cooling tower actuates a Mercoid water-pressure switch that puts the compressor in operation. Thus the compressor cannot start until condensing water is provided. As a safety measure, Mercoid high-pressure cut-outs are provided to shut off the compressors in case of any failure in the system.

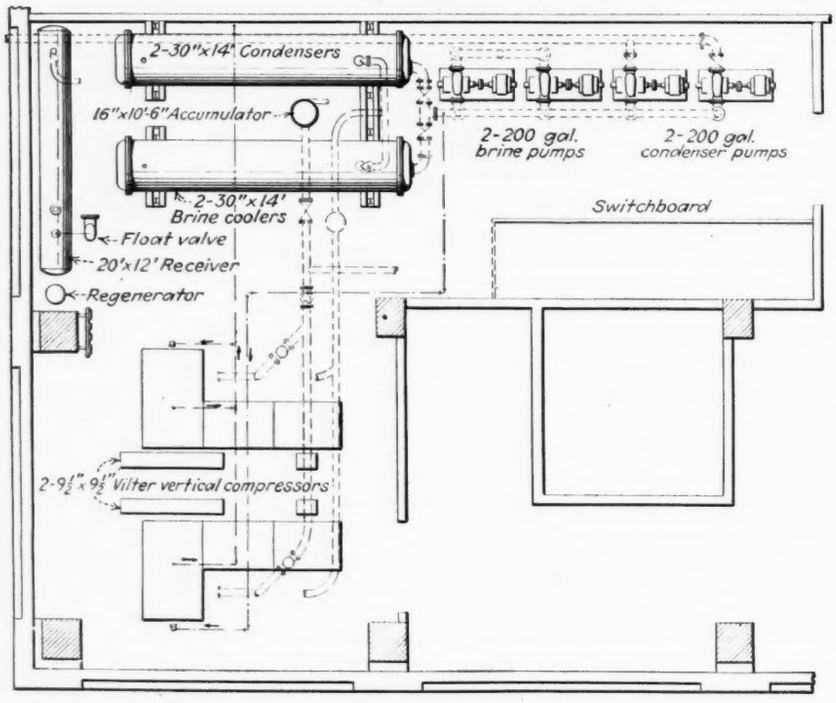


Fig. 1—General layout of the refrigerating plant

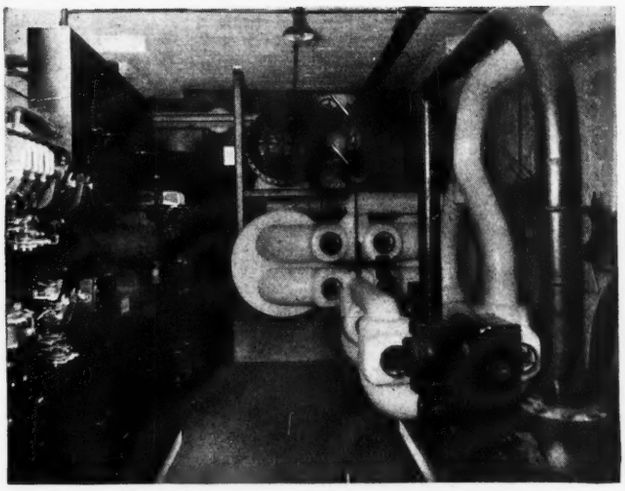


Fig. 3—Brine pumps and control board; brine coolers and condensers in background

With the exception of valves and unit and vessel connections, all piping is welded. Long-radius bends are used instead of manufactured ells, and tees are replaced by welded junctions. A neat installation with a minimum of pipe friction is the result.

Cooling coils in the storage rooms are on the basis of 1 ft. of 1¼-in. pipe to 4 cu.ft. of room volume. All cooler rooms have brine refrigeration. The coils are continuously welded and bent and sectioned for easy defrosting. Freezer coils are placed along the walls as well as overhead and employ direct ammonia expansion for refrigeration. The coils in each room are operated in two sections to facilitate defrosting. A hot-gas connection permits discharge into the section to be defrosted, and the liquid condensed thereby is fed into the section on the other half of the room and evaporated.

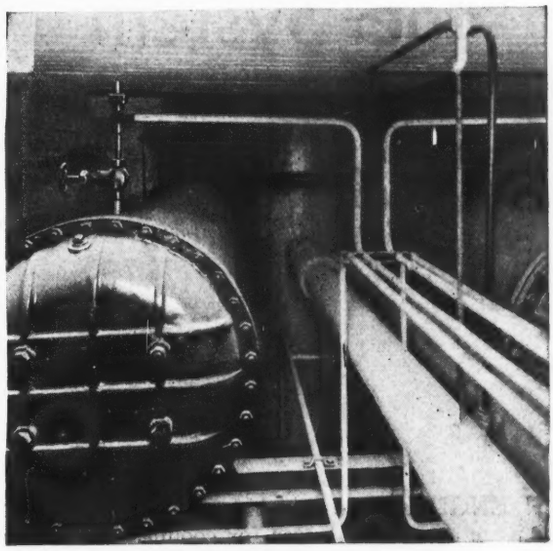
Each of the three banana rooms is arranged for either ripening or storage. The equipment consists of a dry coil unit heater with forced draft. Humidity variation and controlled outside air supply also are provided.

Complete air conditioning and ventilating equipment is provided for the other rooms. Circulation is by two fans of 1,050 cu.ft. per minute capacity. Ventilating piping is carried to each room separately. with heat exchangers to minimize losses in this part of the system and blast gates to provide the desired control to each room.

An ozone machine distributes to each room through aluminum pipe, the supply being controlled by lock-shield needle valves. Each inlet is provided also with an ozone-resisting flow member.

All electrical work was installed with requirements of safety in mind. The main control board is of the dead-front type and provides an oil circuit breaker for the plant supply as well as the automatic and manual equipment. The equipment is grounded in accordance with safety requirements and there are additional grounds where increased safety can be secured thereby.

Plans for the building were made by John M. Marriott, architect, of San Antonio, with the refrigerating engineers of the Central Power & Light Company cooperating. The Velten Construction Company was the general contractor. The mechanical equipment was installed by the Gay Engineering Corporation of Los Angeles, in accordance with plans and specifications by Bloom and Kamrath, Inc., consulting engineers, of Chicago. Loyd, Teale, Dittmar Electric Company, of San Antonio, installed the electrical work.



The vertical accumulator is placed between the brine coolers

Equipment Review, Feb. 10

DURING 1930 upward of 400 pieces of equipment were illustrated and described in the "What's New in Plant Equipment" section of *Power*. To provide a convenient reference for the reader these descriptions have been grouped under suitable headings and are presented in condensed, yet descriptive, form in the Feb. 10 number. It will be a number that the reader will want to keep throughout the year

Cost of Cooling Water Depends Upon the System

By EDWIN BURHORN
Edwin Burhorn Company

AN ENGINEER of an industrial plant needing a large amount of water for cooling should be able to answer the question, Is our water system an economical one? Unfortunately, too few have given sufficient attention to the problem to render a seasoned judgment.

Any cooling system to bring the heated water back to its original temperature is not economical unless it saves enough of the water to pay all the cost of operating the cooling system, maintenance expense, depreciation, and a fair return on the money paid for the cooling system.

These four conditions will be variable with various cooling systems, and accurate studies must be made of the actual value of the four variables before a sound decision can be made of the best system, if any, to be installed.

The cost of operating systems cooled by wind movement only is that for power to pump the water, after it has been heated, back into the cooling tower, and that for the make-up water necessary to replace the water evaporated in the tower and windage loss.

In a fan-type tower, that is, one dependent for cooling on air forced through or drawn from the tower, there is the additional cost for power to operate the fans.

The power for pumping will depend upon the vertical distance between the water level in the suction tank and the top of the cooling tower, and upon the friction of the piping system.

Cooling towers vary in height from about 8 ft. to 35 ft. or over, showing the great diversity in this item alone. An average condition in an economical installation would give a total head of 50 ft., including a 25-ft. vertical lift and 25-ft. friction head. A tower 30 ft. high will require about 25 per cent more power for pumping than a tower 20 ft. high, both operating with a friction head of 25 feet.

The price of current per kilowatt or power per horsepower, and the annual operating time, will determine whether a high-priced, high-efficiency pump or a low-priced, low-efficiency pump will be the more economical.

The quantity of make-up water is variable only in the portion lost by windage, which varies from ½ of 1 per cent in the most efficient type of tower to 5 per cent in unlouvered spray ponds, and may be as high as 10 per cent in fan-type towers operating with a high discharge air velocity.

The annual operating time will determine the expense due to windage, and should determine the first cost economically justifiable. It should not be overlooked that serious consideration must be given to the cost of windage loss due to the possible damage to the surroundings, such as roofs, material, passers-by, and supersensitive neighbors. Many instances are on record of serious and expensive damage suits due to water blowing from a cooling tower to a neighboring property.

In a fan-type tower the cost of operating the fan should be determined.

In refrigeration work or cooling under average air and water conditions it may be safe to figure air at the rate of 100 cu.ft. per minute per gallon of water cooled per minute. To cool 100 gal. per minute would require 10,000 cu.ft. of air per minute. The fans would operate at a resistance in the cooling tower which would vary with the arrangement of the cooling surface and the air space between the individual part of the surface, but which

should be not more than ¼-in. water pressure. The power required will vary with the diameter of the fan and the speed or number of revolutions per minute. The power to furnish 10,000 cu.ft. of air per minute may vary from one to two horsepower.

Where the cooling surface can be arranged to reduce the resistance of the air passing through the tower, the power required will be reduced, but in this case the tower might occupy more ground area and the first cost thus be increased.

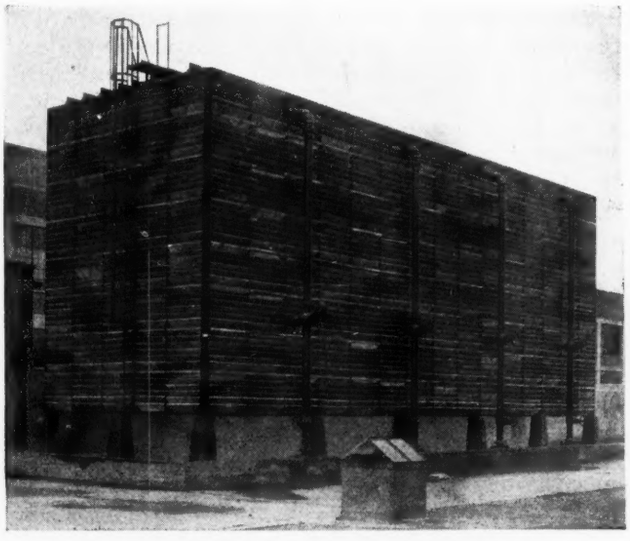
In addition to the power cost for operating fan towers, there will be a charge for the oil necessary for fans and motor. Roller bearings would eliminate this expense, but would add to the first cost.

All cooling systems should be completely emptied at intervals, depending on local conditions, and a charge of fresh clear water supplied. The cooling system circulates practically the same water over and over again, and the surrounding air flows freely throughout the tower at all times, carrying with it impurities that are absorbed by the water.

Continued absorption of weak acid by the cooling water makes a concentration that in time may injuriously affect the material of the cooling system, piping and pumps. That is a fact very largely overlooked; some of the users of cooling systems are fortunate in the atmospheric conditions of their locality. It is possible to neutralize by alkali the acid carried into the tower water, or it may be done by the sodium-dichromate system, as has been suggested by a special corrosion committee of the American Society of Refrigerating Engineers. With a knowledge of local conditions, the danger of serious corrosion can be eliminated.

In a spray cooling system it is necessary to keep the nozzles free from sediment, which would clog them and increase the operating cost. Spray systems, in some cases, use the roof of a building as a collecting basin or pond. This involves a maintenance expense the amount of which depends on the materials used for the roof and the manner in which it is employed. A properly laid roof, although expensive in first cost, is undoubtedly cheapest for the purpose. It will reduce the maintenance of this item greatly.

A fan tower requires steady attention to oiling, adjusting and such repairs as are usually necessary for moving machinery.



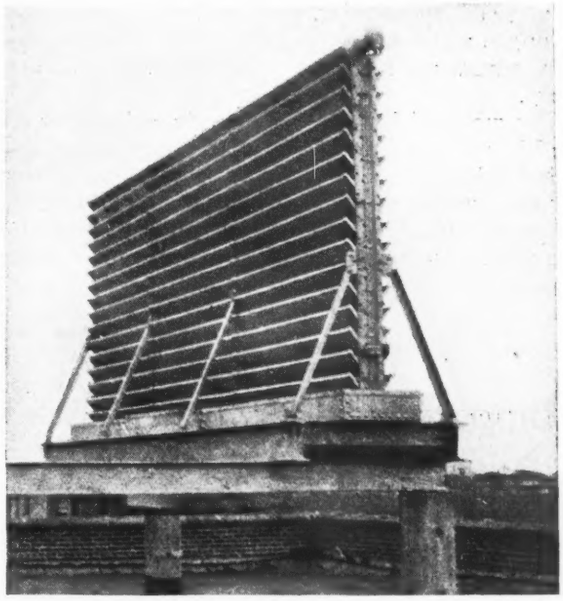
A high tower of large capacity

There is also a possible expense for painting, annually or at intervals, depending on the paint and how it is applied, and also on the local atmospheric conditions. All-steel material should be properly painted, not only in the fabricating shop, but also after erection, and more than one coat is advisable in some cases.

During the past few years some cooling towers were built with the steel work, all castings and all bolts galvanized by hot-dipping after fabrication. Towers so manufactured have been in service nearly ten years with no apparent deterioration of the zinc coating. Such treatment adds to the first cost, but the saving in maintenance expense and depreciation pays a handsome dividend on the investment.

Wood in cooling towers may be treated to increase the life, but the conditions are so severe on wood, especially alternate wetting and drying, that a large expense for the treatment may not be justified.

Ordinary all-wood construction can hardly be expected to last more than seven years, the life depending upon the method of fastening the various parts. Nails of ordinary iron or steel may rust out in a few years, and unless replaced will result in an early failure of the entire



Low-head towers may be made up of a series of such units

apparatus. Some kinds of wood are better in cooling systems than others. Probably the most durable are cypress and California redwood.

In the all-metal construction the frame of the tower or louver fence should be made of heavy steel members, and these should be properly protected from usual corrosion effects by painting or otherwise to insure a frame life of at least 25 years. Such frames are now in service after an active life of over 20 years.

The cooling surface and louvers of a cooling tower are usually made of wood, galvanized iron or pure zinc. The life of these materials will vary with water and atmospheric conditions. Where there is no acid in the water of the cooling system, the life of wood may be seven years, galvanized iron ten years, zinc fifteen years. With acid in the water neither galvanized iron nor zinc should be used. An acid-resisting metal or wood is more durable.

Louver systems are not standardized, and it is possible

to use either a very cheap and short-lived affair, or one designed for high efficiency and of such material that a low maintenance cost and a long life can reasonably be assured. The first cost is consequently exceedingly variable.

It is misleading to compare towers on the basis of ground area only. Some designs require louvers extending outwardly beyond the active cooling surface as much as 2 ft., compared with others extending out only 6 inches.

In some towers the water is sprayed through nozzles at the top. Such towers will require additional power for pumping, depending on the characteristics of the spray nozzles. To reduce the height of a tower, it may be necessary to increase the ground area occupied, which increases first cost of the latter, but the saving in power may soon pay the extra cost.

The louver system of a tower is the most important detail, for if it permits water to blow on to neighboring property a compulsory shutdown may result.

The cheapest form of louver is the plain narrow wood slat system, but this is inefficient and allows of heavy water loss, varying with prevailing wind velocity. A more efficient but more costly type is the built-up system extending outwardly beyond the active cooling surface at an angle of from 45 deg. to 60 deg. and about 2 ft. away from the active cooling surface in all four dimensions. The louvers are made of wood in sections, or are all-metal.

The most efficient and most costly, principally due to the labor of manufacturing, is the narrow louver system. It is fabricated in such a way that there is a free passage for the entrance and escape of prevailing winds, but no direct path for the escape of water, either in drops or in fine mist. The water hits some surface of the louvers, and, due to capillary action, clings to it, the fine mist forming into drops or small rivulets. The wind, if strong enough, may blow the accumulated water to the end of the louver, but will meet a dam, at right angles, making it impossible to get out, and it eventually flows back into the tower system.

The method of distributing the water to the tower at the top is very different in different towers. The perfect tower would distribute the water uniformly over the entire area of the active cooling surface in exceedingly small drops, with sufficient air space to allow air, when wind movements are low, to pass freely between the drops. The more nearly this is reached in the actual tower the greater the first cost.

Other systems, using spray nozzles or similar devices, deliver the water to the cooling surface in circles. This system may involve more or less expense for cleaning out clogged nozzles or surfaces, because that cannot be done without shutting down.

First Cost of Spray Systems

The first cost of a spraying system is fairly well fixed, as it is practically standardized, consisting of the main pipe line, usually cast-iron, standard fittings, branch pipes and nozzles, and suitable supports and expansion rollers.

It should not be forgotten that the space occupied by the cooling system on the ground, outside of buildings, is real estate, and the value of the real estate should be added to the cost of the cooling system.

A spray pond should be surrounded by a louver system to prevent loss of water by windage. Such loss is, of course, an actual waste, and in many cases may result in damage to the owner's premises and processes. It might also be so objectionable to neighbors that a damage suit would result.

▼ ▼ ▼

Comparative Cost of Fuels Easily Found by New Charts

By GEORGE W. HEALD
Mechanical Engineer, Chicago

THE INCREASING availability of natural gas as a boiler fuel, and the continued low cost of fuel oil, frequently invite comparison of these two fuels with coal. The comparative unit commonly used is the fuel cost per 1,000 lb. of steam. To serve a means for a quick and accurate comparison, the charts on the next two pages have been worked out. In Fig. 1 the heat values for the three fuels are arranged to the same scale for combined efficiency in the lower portion of the chart. Likewise, the cost of the three fuels are placed relative to a single scale showing the fuel cost per 1,000 lb. of steam. Near the center of the chart will be found diagonal lines that show the effect of the factor of evaporation. Following the proper diagonal before reading the cost figure gives the actual cost—that due to the actual evaporation for the steam pressure and feed-water temperature conditions, as reflected in the factor of evaporation.

Use of the chart is comparatively simple. Starting with, say, 78 per cent boiler and furnace efficiency at the lower lefthand corner of the chart, move horizontally to the 12,000-B.t.u. coal curve, then vertically to the top line of the lower portion of the chart. The factor of evaporation diagonals start from that line. Move parallel to the nearest diagonal until the correct factor-of-evaporation line is reached. Then move vertically to the ton price of coal. To the left will be found the cost in cents of the coal required to evaporate 1,000 lb. of steam.

For oil the fuel cost is found in the same way, using the middle portion of the chart. Assuming the same efficiency as before, 78 per cent, move to the intersection with the diagonal for 18,500-B.t.u. oil; then vertically to the line of equivalent evaporation; diagonally to the horizontal line or space having the correct value for the factor of evaporation; then vertically to the cost of oil per gallon, and horizontally to the fuel cost at the extreme left or right.

When gas is the fuel the cost of generating 1,000 lb. of steam is found in the same way, using the group of curves at the right of the chart. The dotted line for 78 per cent efficiency has been extended to intersect both the usual value of natural gas, 1,000 B.t.u. per cubic foot, and for Chicago gas with 530 B.t.u. per cubic foot.

The chosen alignment of the fuel costs affords an interesting comparison. Starting with the fuel cost found in the first example with coal, which is a fraction above 16c. per thousand, this line is extended horizontally to the right until it crosses all of the vertical lines used in the previous examples. It will be seen that to equal

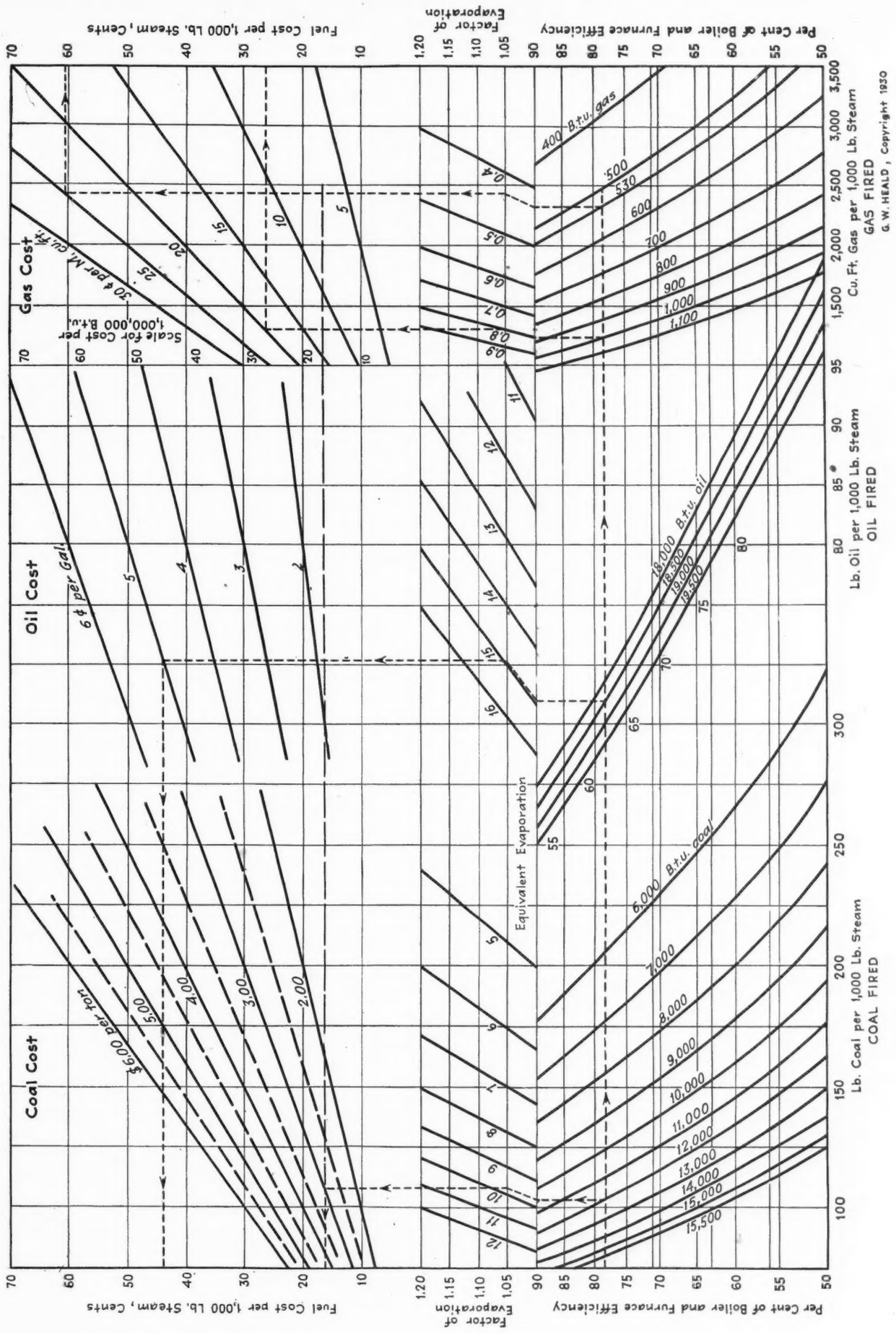

Coal Cost
Oil Cost
Gas Cost
Scale for Cost per 1,000,000 B.t.u.
Fuel Cost per 1,000 Lb. Steam, Cents
Factor of Evaporation
Equivalent Evaporation
Per Cent of Boiler and Furnace Efficiency
Lb. Coal per 1,000 Lb. Steam
COAL FIRED
Lb. Oil per 1,000 Lb. Steam
OIL FIRED
Cu. Ft. Gas per 1,000 Lb. Steam
GAS FIRED
G. W. HEALD, Copyright 1930

FIG. 1—CHART FOR COMPARISON OF THE RELATIVE COSTS OF STEAM PRODUCED BY COAL, OIL AND GAS

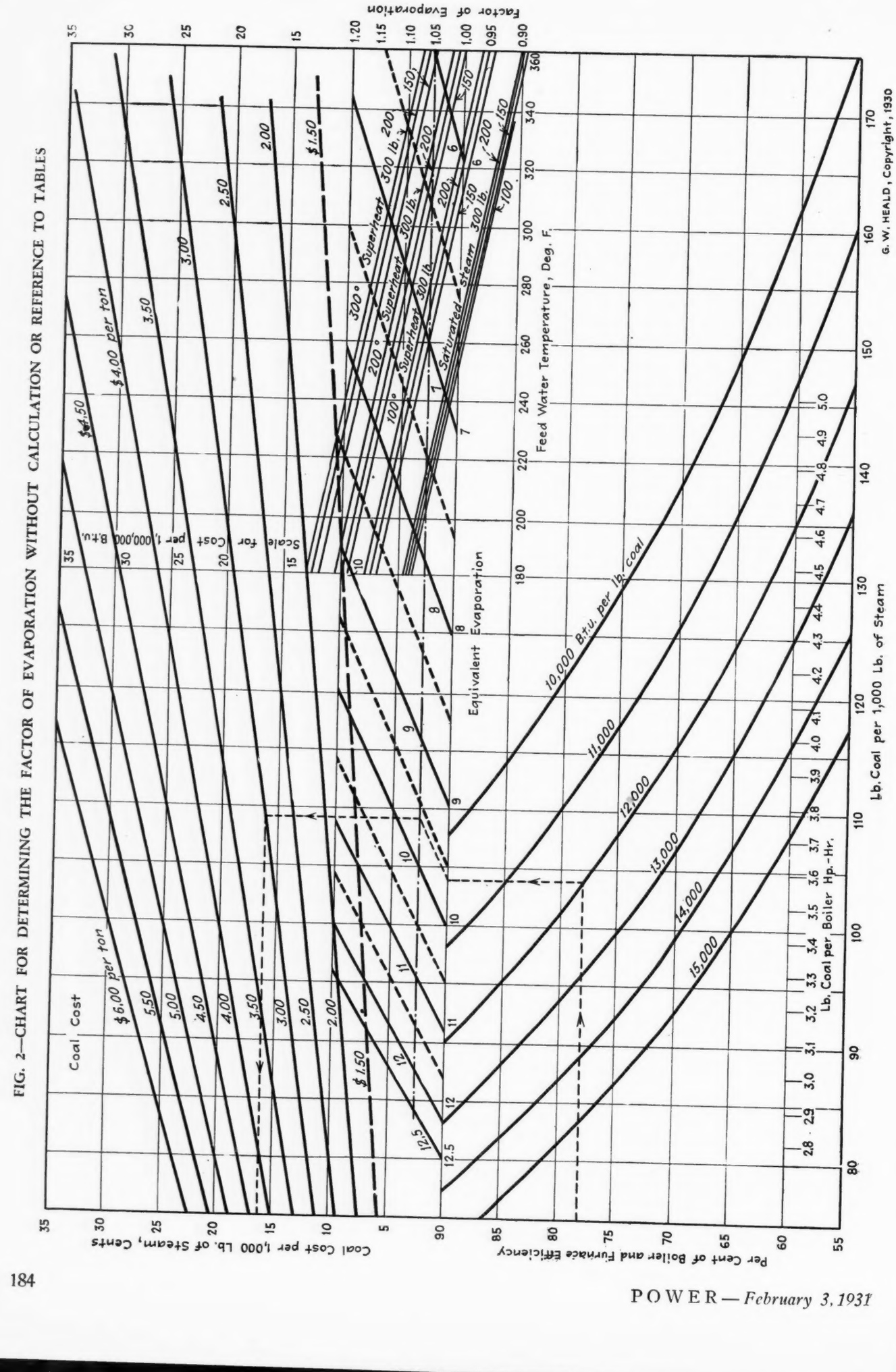


FIG. 2—CHART FOR DETERMINING THE FACTOR OF EVAPORATION WITHOUT CALCULATION OR REFERENCE TO TABLES

the cost of coal as fuel under the assumptions chosen, oil would have to be purchased at less than 2c. per gallon; likewise, natural gas would have to be purchased at about 12c. per 1,000 cu.ft. and 530-B.t.u. gas at 7 cents.

In the upper portion of the chart, to the left of the lines marked *Gas Cost*, is a scale from which can be read the fuel cost in cents per million B.t.u., when so desired.

Special Chart for Coal

For the convenient reference of coal users, an enlarged chart (Fig. 2) embracing heat values ranging from 10,000 to 15,000 B.t.u. per pound of coal, is presented. It differs from the coal section of Fig. 1 only in the group of diagonal lines at the right of the center for saturated steam and superheat of 100, 200 and 300 deg. These diagonals are so placed in reference to the vertical feed-water temperatures that the intersection of the diagonal and the vertical falls in the proper relation to the scale at the right marked *Factor of Evaporation*. Thus the factor of evaporation can be determined graphically without calculation or reference to tables.

In using the chart it is advisable to draw a line through this intersection of steam pressure with feed-water temperature and extend it far enough to the left to meet any of the diagonals rising from the equivalent evaporation line.

In the middle of the upper portion of the chart will be found the scale showing the relative cost per 1,000,000 B.t.u.

Near the bottom, in addition to the scale showing the quantity of coal needed to evaporate 1,000 lb. of steam, will be found an additional scale showing the pounds of coal per boiler-horsepower, a figure that frequently will be found useful.

One of the main objects in developing this second chart has been to show graphically the actual evaporation as related to the equivalent evaporation, and to arrive at, with little effort, the cost of the coal and the quantity of coal required, both on the actual basis for the conditions under consideration. Many diagrams have been published giving the figures on the basis of equivalent evaporation, or from and at 212 deg., but few have tried to give results on the actual basis.

It may be helpful to some readers to explain the lower portion of the chart, which is first figured on the equivalent basis. The heat required to evaporate 1,000 lb. steam from and at 212 deg. is $1{,}000 \times 970.4 = 970{,}400$ B.t.u. The heat absorbed from a pound of coal equals the B.t.u. in the coal, times the efficiency expressed as a decimal. The B.t.u. required, divided by the effective B.t.u. in the coal, equals the pounds of coal required to evaporate 1,000 lb. of steam, the figures shown along the bottom of the chart.

Where the actual evaporation is already known, the starting point should be the intersection of the factor of evaporation with the diagonal representing the known actual evaporation. Move vertically to the cost per ton of coal and then horizontally to get the coal cost per 1,000 lb. of steam; or vertically downward to get the quantity of coal required. But to determine the per cent efficiency being obtained, move down the diagonal to the left as far as the equivalent evaporation line, then vertically down to the B.t.u. value of the coal being used and horizontally to the left for the efficiency.

Many relations, not fully appreciated otherwise, are clearly revealed through study, or continued use, of this chart.

Electrical Maintenance Brings Its Reward

By R. HOLT

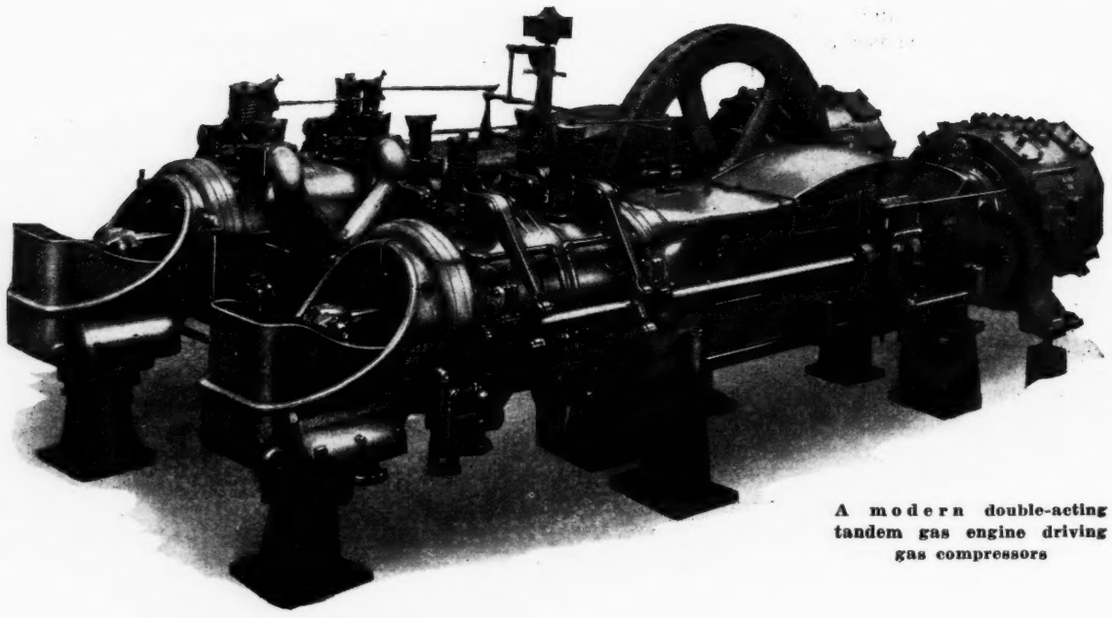
A RECOGNIZED and outstanding advantage of electric drive is the ease with which motor-driven machines may be operated, even though the control equipment utilized is practically obsolete. Most manually started motors up to 300 hp. can safely be started by any intelligent machine operator if he has been properly instructed by a competent supervisor. Supervisors should be thoroughly trained by an electrical worker to properly start, operate and stop all electrical equipment in their section or department, the operation of which is not so complicated as to require the attention of an electrician or electrical operator.

Push-button control has rightly become popular for starting motors of all sizes and types. This control, when properly applied, almost entirely eliminates the uncertain human factor, which alone is so largely responsible for excessive maintenance costs.

Electrical equipment, particularly in the industrial control class, requires regular inspection to insure reliable operation. The interval between these necessary inspections can be greatly increased by insisting that all machine operators follow instructions. A machine operator, or even his immediate supervisor, has no business using a test lamp or reloading fuses. Fuses can be safely changed by the machine operator or his supervisor, providing: that proper training has been given, that the rating of spare fuses is marked thereon, and that the ratings of the fuses to use are marked on the fuse holders. Blowing of fuses and relay operations should be promptly reported to the electrical department, and not more than one complete set of fuses should be replaced by other than an electrical worker.

There is no excuse for burn-outs and short circuits, and their attendant serious consequences, occurring in a well-organized industrial plant because of forgetfulness or bungling on the part of a machine operator. Such troubles should not be tolerated, and can be avoided if machine hands are carefully selected and given a little training. However, machine operators are not the only class of workers whose acts cause serious trouble. I know of several cases where death and destruction of equipment resulted from errors made by experienced electrical operators or electricians. Only exceptionally well qualified men should be employed in any electrical department if freedom from a multitude of troubles is desired.

Many small plants employ a handy man or general mechanic to look after the electrical equipment, often with dire results. Unfortunately, in some fairly large industrial plants that could easily afford to maintain a well-organized electrical department, one underpaid and overworked electrician, with one or more poorly paid, inexperienced helpers, carries on. Meanwhile the electrical equipment rarely has proper care. On the other hand, many industrial plants maintain well-equipped electrical departments under the supervision of a trained engineer. This policy brings its reward in the form of freedom from troubles, a high operating efficiency, assurance that the electrical equipment is always in first-class condition, and a practically uninterrupted production schedule.



A modern double-acting tandem gas engine driving gas compressors

Improved Details Raise Gas Engine Efficiency

By V. L. MALEEV, M.E., Dr. A.M.*
Stillwater, Okla.

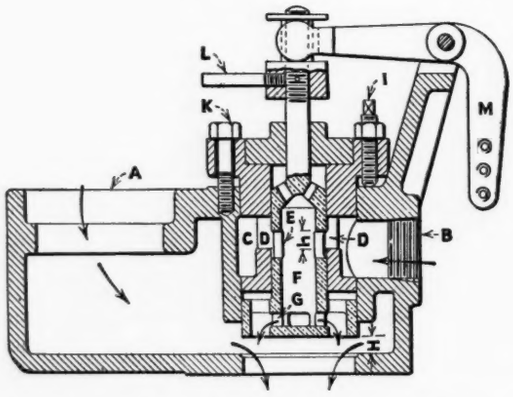


Fig. 1—A design combining both gas mixing and power regulation

The gas engine of today is a distinct advance over the type produced 20 years ago. Advance in gas mixing valves has raised the efficiency a substantial amount

BOTH in America and in Europe the gas engine had attained its highest development and extensive application shortly before the outbreak of the World War. The expiration of the diesel patent in the United States in 1912 and the following evolution of the diesel engine and the disappointment in the producer-gas engine changed the situation, pushing the gas engine gradually to the background. The gas engine was considered only in cases when special cheap fuel was available, as blast-furnace or coke-oven gas.

The feverish drilling activities in the oil fields, opening of new natural gas fields of tremendous capacities, laying of a highly developed network of gas lines, and the resulting low rates for natural gas, particularly when sold for industrial purposes, have resulted in the rejuvenation of the gas engine, this time decidedly as a natural-gas burner.

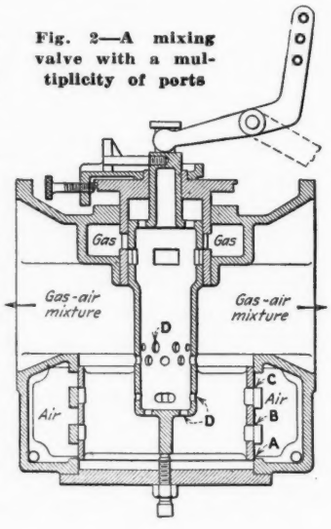


Fig. 2—A mixing valve with a multiplicity of ports

A large number of gas engines are used by the oil industry, but a great and steadily increasing propor-

*Professor of Mechanical Engineering, Oklahoma Agri. and Mech. College, formerly chief engineer Western-Enterprise Engine Co., Los Angeles, Calif.

tion is used in other industries. Whenever a new gas pipe line is laid, new gas engine pumping plants are built for irrigation and factories install gas engines.

The old rivalry between the four- and two-stroke cycles continues, with the four-stroke-cycle engines remaining in the lead. The majority of gas engine manufacturers build four-stroke-cycle engines only, a few build both four- and two-stroke-cycle engines and still fewer construct two-stroke-cycle engines only.

In comparing the proportion of horizontal to vertical engines we find that about nine horizontal engines are built to one vertical. Only six manufacturers in this country build double-acting engines and only five of them build tandem and twin-tandem engines.

The speed of industrial engines varies from 80 to 330 r.p.m. and the average piston speeds lie between 600 and 900 ft. per minute, with a tendency toward the higher limit of about 800 ft. per minute, although some have been built to run at 1,000 feet.

In days gone by, when only part of the natural gas was utilized and the rest wasted, the gas consumption of natural-gas engines, which were used mostly in the oil fields, was of minor importance. The crudest, simplest gas engine, using up to 13,000 B.t.u. per brake horsepower-hour, or having a thermal efficiency of less than 20 per cent, was good enough. The present medium-sized natural-gas engines use, at full load, not over 10,000 B.t.u., corresponding to 25.5 per cent thermal efficiency, and some manufacturers report tests showing a fuel consumption equivalent to 9,000 and even 8,500 B.t.u., or thermal efficiencies of 28 and 30 per cent.

Such high efficiency has been attained in four-stroke-cycle engines by giving a proper shape to the combustion space, without dead pockets and large cooling surfaces, by improving the gas-air mixing devices and by the use of efficient magnetos and spark plugs.

In two-stroke-cycle engines the thermal efficiency has been improved by shaping the combustion chamber so as to set up sufficient turbulences to obtain thorough mixing of gas and air, and complete combustion by so arranging the air ports to obtain complete scavenging of the cylinder and by admitting the gas after the beginning of the compression stroke, actually injecting it after the scavenging is completed.

Although there are no fundamental departures in the design, former experience with gas engines and more recent innovations in oil engine construction have influenced the design of several gas engine details.

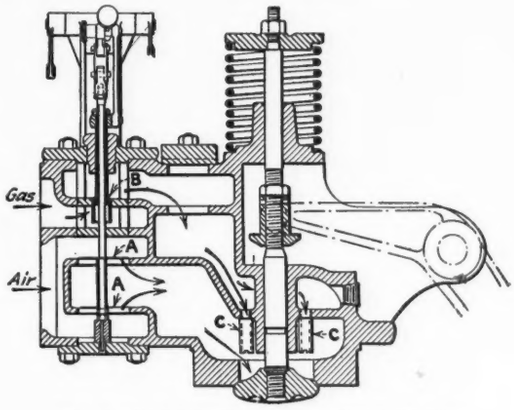


Fig. 3—Gas nozzles insure a thorough air-gas mixture

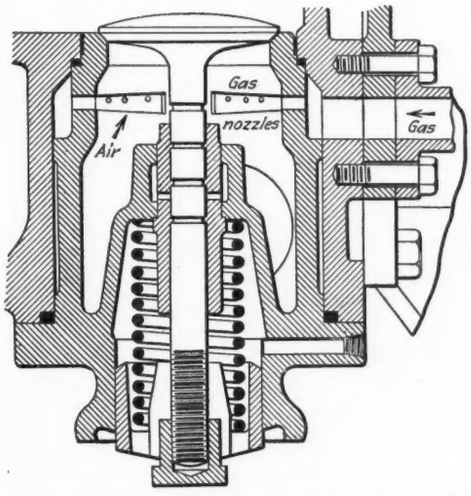


Fig. 4—Introduction of gas close to the air valve

The mixing device is one of the most important parts of a gas engine, particularly of a four-stroke-cycle type, in regard to fuel economy. The mixing devices can be divided into three groups: In the first group air and gas are mixed in a separate mixing box and the mixing valves are under the control of the governor and act also as throttle valves for power regulation. In the second group the governor acts upon separate air- and gas-throttle valves, but the mixing is effected only immediately before the admission to the cylinder. Finally, a third group comprises engines with quality regulation where the air-gas mixture is changed according to the load. At present this system is used only in very large engines.

A combined mixing and power-regulating valve as developed many years ago for natural gas engines by a Pacific Coast engine-building concern is shown in Fig. 1. At present this type of valve is used by several other engine builders, for horizontal as well as for vertical engines.

The mechanism is based on throttling action both for mixing and regulating. *A* is the air and *B* the gas intake. From a ring chamber *C* the gas passes into the hollow valve stem *F* through slots *D* in the body and slots *E* in the valve; from there it goes through ports *G* into the air stream. Mixing of gas and air is effected by the breaking of the gas in several small streams having a high velocity. The proportion of gas to air can be adjusted by slightly turning the valve by a handle *L* and thus changing the size of the effective area of the upper ports which are formed by the slots *D* and *E*.

For power regulation, the governor connected to the bell crank *M* raises or lowers the valve and thus changes the air admission height *H*, and the effective height *h* of the gas ports, leaving the ratio of areas, and hence the mixture proportion, unchanged.

Another feature of this construction is the adjustment of air or gas lead by a pair of jack screws *I* which in combination with the hold-down screws *K* permit raising or lowering of the valve body.

A similar valve designed for a two-cylinder unit and having triple air admittance, *A, B* and *C*, and a number of gas holes *D* for obtaining a more complete mixing appears in Fig. 2.

Other mixing valves belonging to the same group use balanced-disk valves instead of sleeve valves. Their construction is more complicated but they have the advantage of smaller friction resistance and better balancing without any reaction on the governor.

An arrangement belonging to the second group and consisting of a combination of a throttle-valve and intake in shown in Fig. 3. Air is admitted and regulated through a balanced double-disk valve *A*, and the gas through a conical plug valve *B;* mixing is accomplished by a number of nozzles *C* immediately before admission to the cylinder. The proper gas-to-air proportion is adjusted by lowering or raising the gas valve on its stem. Sliding surfaces, friction, possibility of sticking, and reaction upon the governor are eliminated through this design.

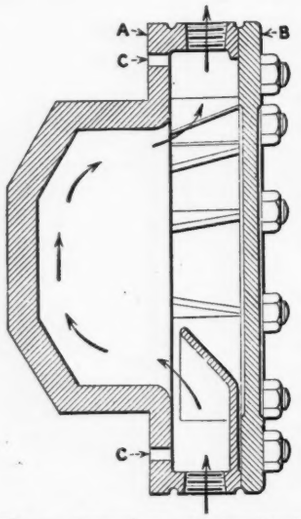


Fig. 5—Two-piece cylinder head eliminates fractures

In some engines the air and gas are conducted separately to the inlet and only there mixed by means of flaring-out, radially located gas nozzles, as in Fig. 4. Impingment of the gas streams on the valve stem assists the mixing action.

In the third group of mixing devices, where the governor changes both the mixture proportion and the amount of charge admitted, mixing of gas and air is usually accomplished by gas nozzles similar to those shown in Fig. 4.

One of the weak points of some four-stroke-cycle gas engines is the location of the intake and exhaust valves in the cylinder head. The severe stresses set up by great temperature differences result either in a direct cracking of the cylinder heads or, with a better design, produce a fatigue of material which ultimately also results in breaking of the cylinder head, sometimes after several years of operation. Some engine designers tried to change the material and to substitute cast steel for the cast iron usually used. However, if the design is not correct the trouble will not be cured and fatigue of the material will sooner or later appear in the form of a crack in the most strained point.

In the modern engines this trouble is virtually eliminated by providing efficient water-cooling to every point of the head and by designing the cylinder head as symmetrical as possible, with uniform or gradually changing thickness of all walls.

To eliminate the danger of high temperature stresses, unavoidable with the use of double walls, one engine builder has patented and uses a rather original method. His cylinders and cylinder heads are single-wall castings set in a tank filled with water; this tank has for its bottom the top of the crank case, to which a cast iron box, open from both ends and provided with flanges, is bolted.

Good cooling of the cylinder head is important not only for the strength of the head, but also for the efficiency of the engine itself. Scale deposits readily in the cylinder head jacket, where the highest temperatures occur, and gradually impairs the cooling up to the point that pre-ignition can begin and the engine will start to knock. One solution is a simple two-piece cylinder head, Fig. 5, in which the separate cover *B* insures easy and thorough cleaning; holes *c* assist the water circulation through the exhaust and inlet valve cages.

Contrary to modern oil-engine practice, only a few of the gas engines receive separate liners. The majority of engines have cylinders cast in one piece with the water jacket. Some of the latest engines have pushed-in liners in the exact meaning of the word; in other engines the liner is combined with the intake- and exhaust-valve receptacles, as in Fig. 6. The design is symmetrical and reduces the cylinder head simply to a water-jacketed cover, but has the drawback of being an expensive piece to renew.

There is a decided tendency to making the trunk pistons lighter in order to take care of the gradually increasing speed requirements. Reinforcing the bottom of the piston by inside ribs permits reduction of weight without danger of weakening the piston or of impairing its capacity for carrying away the combustion heat.

It may be of interest to note that three engine builders are still using "make-and-break" igniters. One of these manufacturers came out with a new engine about three years ago and retained this type of ignition. Other builders are using modern high-tension magnetos with spark plugs. Some use oscillating magnetos, some rotating.

Designers are paying much attention to reduction of friction. Ball and roller bearings are commonly used for the layshafts operating the valve mechanism, and for governors. One manufacturer has built a number of gas engines equipped with roller bearings on the crankshaft, layshaft and governor shaft to meet a special order of an oil company. Another builder puts out a four-stroke-cycle engine for oil field work which has roller main bearings as standard equipment. The advantages of roller bearings in respect to friction reduction and simplification of lubrication problems are obvious. It will not be surprising if most single-throw crankshafts eventually are equipped with this type of bearing.

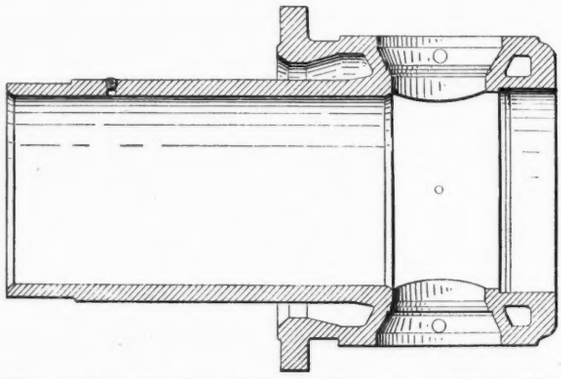


Fig. 6—A design in which the liner is provided with a valve box

The trend of the natural-gas engine development can be seen best from the number and size of the new installations. There is an evident tendency toward larger units, although naturally the starting points are very different: In the oil fields the pumping engine has grown from about 30 to 60 and even 75 hp.; small engine-compressor units have changed during the last few years from 45 to 220 hp. and probably will go up to 300 hp. With increasing lengths of pipe lines and increasing gas consumption, booster compressors, which started as 200-to-400-hp. units, gradually were superseded in the newer installations by 750-to-1,000-hp. units.

Irrigation installations show a similar increase; having started with 25-hp. engines, farmers and rural water companies now use 160-to-200-hp. engines, and several deep-well pumps in Southern California are driven by 400-hp. units.

...RIGHT OUT OF THE PLANT...

Single-Phase Operation Blows Motor Fuses

SEVERAL three-phase motors were installed in a building and supplied from a two-phase line through Scott-connected transformers. They operated satisfactorily for a while, then a condition similar to single-phase operation seemed to exist and the fuses on the motors opened. Examination of the fuses at the transformers and at the main switch and branches showed everything to be all right. It was not until voltage measurements were made that the trouble was discovered.

The connections in Fig. 1 give a uniform voltage on the three phases. When the voltage measurements were made the conditions were found to be as in Fig. 2, which are those obtaining when both transformers are connected

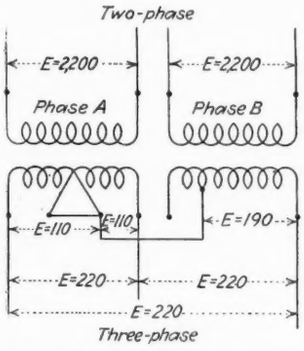


Fig. 1—Transformers connected to change two-phase power to three-phase

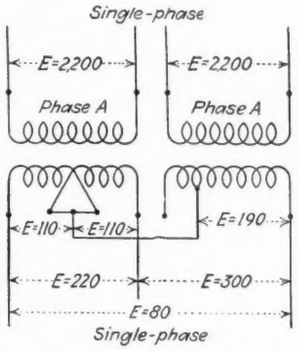


Fig. 2—Voltage distribution found on the transformers on single-phase operation

to the same phase. At first this was puzzling, but a search of the circuit revealed a switch that had been in use at one time to transfer load from one phase to the other. When no longer required, the switch was closed to the *B* phase and forgotten. No more was thought about it until one day an attendant threw it to the other position and in doing so connected both transformers to the same phase.

HENRY MULFORD.

Patchogue, N. Y.

Reduced Steam Pressure for Kettles

REFERRING to the question and answer on the gain from reducing pressure for kettle-rendered lard, page 74, Jan. 13 number, the question is not pertinent to cost of rendering lard, but is so to quality. Tanks for kettle-rendered lard are built for working pressure of 40 lb., the steam inlet and outlet are of ample size, and, unless specifically permitted otherwise, there must be a steam gage and pop safety valve between the reducing valve and kettle. Kettle lard is rendered at 40 lb. steam pressure, for the reason that at a higher pressure the lard would become discolored, as a result of the olio oil being burned, and the product would be off-color, say, from slightly gray to a dark gray, which would make it hard to market. Of course, the lard could be bleached white, but that would run up the cost. Since a quality product is obtained at 40-lb. steam pressure, with minimum labor and the least amount of machinery, why use higher steam pressures?

Steam lard is rendered at 60 lb. steam pressure, and as the process water is in contact with the product, no discoloration occurs. With the internal-pressure machines, the steam pressure is in conformity with the process, which is governed by the internal pressure; one manufacturer uses 80-lb. steam, another 40-lb. The large packers are all installing them, as they are more economical to operate, and some of the finished product brings a better price.

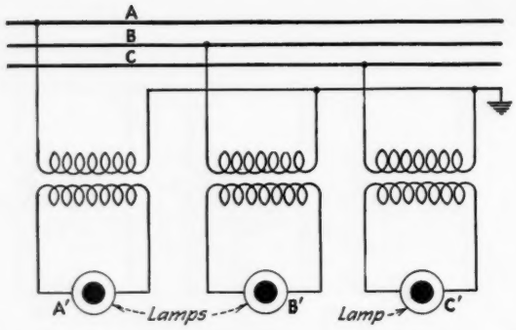
In kettle-rendered lard the steam pressure will not have any bearing on the time consumed in rendering if the steam trap is in good order; the stock to be rendered is the element that determines the time.

St. Louis, Mo. C. B. PEMMO.

A Ground Detector for Three-Phase Circuits

FOR USE on 2,300-volt, 3-phase normally insulated circuits, a ground detector may be made from three small potential transformers and three lamps connected as in the figure. The transformers are of a design suitable for the full voltage of the line and the lamps as selected for the normal secondary volts of the transformers. As long as the system is insulated each transformer is subjected to the star voltage of the system, or 58 per cent of line-to-line volts. Consequently the voltage on the lamps will be only 58 per cent of normal secondary value and they will be dimly lighted.

With a low-resistance ground on one line, the lamp connected to the transformers on this line will go dark and the other two will light up to normal. For example, a low-resistance ground on line *A* will cause lamp *A'* to go dark and lamps *B'* and *C'* to light up to normal. This is because the ground at *A* short circuits the transformer connected to that line and applies full voltage to the transformers connected to the other two lines. If the



Three transformers connected as ground detectors on a three-phase line

ground at *A* had a comparatively high resistance, lamp *A'* would be dimmer than normal and lamps *B'* and *C'* would increase in brilliancy, but not to full-voltage condition. Any change in the brilliancy of the lamps indicates a ground on one line, the fault being on the line to which the dimmest lamp is connected.

RALPH E. MACKAY.

Butte, Mont.

Galvanized Pipe in Refrigerating Systems

STEEL and iron pipes that are well galvanized and rustproof, and for this reason should serve to good advantage in condenser coils and other piping constantly exposed to moisture in refrigerating plants. But the galvanizing should be limited to the outer surface of the pipe. A zinc coating on the inner surfaces of pipes carrying liquid or gaseous ammonia, as liquid lines and headers and the branches leading to expansion coils, is useless. The pipe's immunity to corrosion from the fluid passing through makes it so.

Expansion coils, in many cases, are continuously frosted. The frosting serves to insulate the coils against moisture. Since no rusting can occur, galvanizing is unnecessary. The outer pipes and the water headers of double-pipe ammonia condensers are subject to rusting, especially on their outside surfaces, and should be galvanized, and if the condensing water is of an acid nature it would appear that the internal surfaces of the inner pipes should be galvanized, too.

The testimony of engineers who have used galvanized pipe in contact with ammonia varies considerably. Some claim that to galvanize the inner surfaces of ammonia pipes is a sure way to invite trouble, as the galvanizing will be eaten away and a chemical reaction detrimental to the charge of ammonia will occur. Others assert the contrary, giving instances of ammonia condensers built of pipes galvanized both inside and outside having been used for years without injurious effects.

In those cases where disintegration of the galvanizing has occurred, it is probable that the high temperature of the ammonia vapor is the explanation. This theory was borne out in one instance where it was found that the galvanizing on the insides of the upper pipes of an ammonia condenser had peeled off completely, while the coating on the lower pipes was unimpaired. Apparently, the hot vapor coming in from the compressor had done the damage at the top—the destructive action vanishing as the ammonia cooled and liquefied in the lower pipes.

St. Louis, Mo. J. A. DEVELLE.

Social and Industrial Anomalies

FROM some slight experience with mass control by bureaucratic dictatorship, I do not look forward with unmixed joy to the time when "our essential industries will be run as a unified, regimented, interrelated whole," as mentioned in the Jan. 6 number.

Whether there exists, or can be devised, a social regulator or governor sensitive or intricate enough to supply to each and every individual at all times just those things which he most desires, needs or deserves, while at the same time eliciting from him productive activities in just those lines in which he is most adept or which are most required by others, appears highly doubtful. In mechanics, the best kind of governor is one which responds directly and in measure to the thing governed, which, in the present case, is the consuming and producing unit—the individual himself.

The reason why the productive machine stands idle while "thousands are needing" is that, generally speaking, these same thousands have over-bought and exhausted both funds and credit.

What is needed, apparently, is moral education of the individual to take the responsibility of providing for his own future. Workers and wage-earners use the bulk of all goods, and when there is a lack of market and depression in trade the source is to be sought there.

The wage-earner has both the opportunity and the duty to accumulate savings. In other words, when times are good, work plentiful and prices high, he should not spend his entire income for pleasure and luxuries, but keep some of it, in the form of requisitions payable on demand, upon which he can draw and thereby command the labor and products of others when and as required, particularly when work is scarce, wages low and goods cheap. This practice, if followed by even a fairly large percentage of the population, would do much to level off the peaks of inefficient over-activity and fill in the sluggish valleys of depression. A more widespread diffusion of Scotch thrift might soften, or avoid altogether, the next decline in trade and employment.

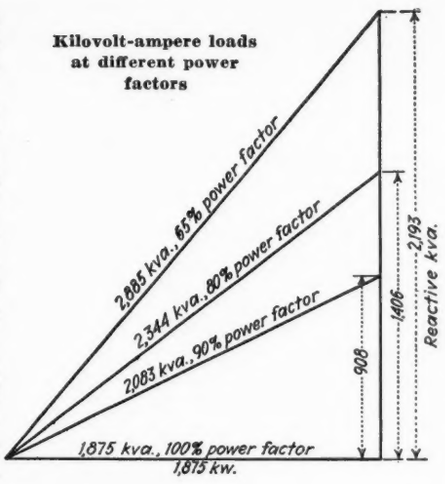
New York City. GEORGE H. GIBSON.

Methods of Correcting Power Factor

IF IT is desired to reduce the kilovolt-ampere demand from the generating equipment, as stated in the question on page 947, Dec. 9, 1930, number, it can be done in two ways: By changing the induction motors in the plant so that each is fully loaded; and by the use of condensers, either synchronous or static. A 200-hp. motor doing only 100 hp. of work operates at a low power factor. If replaced by one of 100-hp. rating, the power factor will be improved. To carry this method out completely it would be necessary to make a survey of the plant and measure the power taken by each motor, and, in cases where motors are not fully loaded, replace them with smaller ones of the correct rating for the drive. It is probable that this might prove uneconomical, and sometimes it is necessary to use motors larger than normally required for the load.

The use of a synchronous or static condenser probably offers the best way to correct the power factor. When a condenser is installed, some of the capacity that would

otherwise have to be included in the generator may be omitted, as it is supplied by the condenser.



The diagram shows the total kilovolt-amperes for 1,875-kw. load at 65, 80, 90 and 100 per cent power factors. The figures on the right-hand side of the diagram show the reactive kilovolt-amperes associated with the load at the same power factors. To correct the power factor of this load from 65 per cent to any other would require a condenser whose rating is equal to the difference between 2,193 and the reactive kilovolt-amperes associated with 1,875 kw. for the desired power factor. It will thus be seen that the size of condenser necessary to correct the power factor to 80, 90 and 100 per cent is 871, 1,285 and 2,193 kva., respectively.

The above figures, being the actual kilovolt-amperes needed, do not work out to even figures, and the next larger standard size should be used.

The choice between synchronous and static condensers is influenced by economic considerations. Synchronous condensers have a lower first cost, but have higher losses and require a certain amount of skilled attention. Static condensers have a higher first cost, lower losses than a synchronous condenser, and require little or no attention. In this case, where generators are already installed, it would appear that the synchronous condensers are the most economic solution.

If the power factor is corrected to 80 per cent, the relationship between the reactive kilovolt-amperes and the kilowatts is the same as that for which the generators were designed, but there is no provision for additional load or low power factor. On the other hand, it is seldom economical, and in this case most certainly not, to correct the power factor to 100 per cent, because of the large condenser capacity necessary to correct from 90 to 100 per cent. It appears that a 1,500-kva. condenser, which is the next larger standard rating above the capacity required to correct the power factor to 90 per cent, would be the most economical.

J. R. DUNBAR, *Elec. Eng.*,
Canadian Westinghouse Co., Ltd.

Hamilton, Ont.

✦

IN SEPTEMBER, 1929, we installed a synchronous motor in our plant to correct the power factor. Our connected load of approximately 500 hp. consists of induction motors ranging in size from fractional horsepower to 50. Some of these drive individual machines and others drive lineshafts.

The power factor on this system averaged about 60 per cent, and as a result we were paying a penalty of about $42 a month, or $504 a year, on our power bills. We were not primarily interested at the time to increase the capacity of our power system, but had in mind eliminating the penalty charge. However, we were in need of a stand-by generator that could be driven by a steam engine in the plant. A synchronous motor was decided upon to correct the power factor, and also to be belt-driven by the steam engine to generate current to drive an induction motor connected to the blower on the cupola to prevent a possible freeze in case the city current was off for any length of time. The motor selected was a 100-hp., 80 per cent leading power factor unit with a direct-connected exciter and a regular pulley on the opposite end of the motor's shaft.

Since the motor's installation we have not had to use it as a generator; but running it idle, without any mechanical load, the power factor is boosted to 80 per cent, thereby eliminating the penalty charge. Since the initial cost of this equipment, including installation, was approximately $2,000, the saving in the power bills will retire the motor's cost in 4 to 5 years, after which a direct saving of $500 to $600 per year will be realized, besides having the unit as a stand-by generator.

Had additional capacity been needed, we could have added approximately 160 kva. load without any additional current flowing in the system, as compared with original conditions.

R. H. PARRISH, *Sales Engineer*,
Alamo Iron Works.

San Antonio, Texas.

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THERE are several means of correcting power factor, and the one should be used that is best suited to the plant in question. The improvement can be accomplished by:

1. Standard induction motors that will give the highest power factor consistent with the operating conditions.
2. Synchronous motors.
3. Capacitors.
4. Synchronous condensers.

A load of 1,875 kw., with a power factor of 65 per cent, would overload the two generators mentioned in the question, but with the third unit in service the plant would have ample capacity, but might have trouble if one unit had to be taken out for repairs, as two would not be able to carry the peak load at the present low power factor. If the power factor were raised to 75 per cent, two generators could carry the load.

The motors range from 200 hp. in size down. If there are several induction motors of high horsepower, say, 30 or above, it would appear that substituting synchronous motors for some of the large induction machines is the best method of improving the power factor. This would be much cheaper than putting in new generating equipment.

If some of the induction motors could be replaced with 0.80 power factor synchronous motors, it would require 670 kw. of these motors to increase the power factor from 65 per cent to 90 per cent. If the plant can use the steam and one of the units could be floated on the line, it could be made to carry most of the wattless current. This would improve the conditions considerably; but unless the steam can be used for heating or other purposes, it would be a more or less expensive way of obtaining the desired correction.

Hartford, Conn.

C. N. JOHNSTON,
Power Plant Engineer,
The Pratt & Whitney Aircraft Co.

From Among Readers' Problems

Conducted by
L. H. MORRISON

RIVET HEADS BREAK—*I find that rivet heads break off on the seams of our boiler. What causes this? Is it dangerous?* I.M.

The trouble probably is caustic embrittlement. You should call in the boiler inspector, for the condition is dangerous and the plate may be cracked between the rivets holes, which means that you are likely to have an explosion any day. It is possible that the rivets were over stressed at the junction of the head and shank when they were driven up during the boiler manufacture.

DIESEL EXHAUST TEMPERATURES—*On our four-cylinder diesel the pyrometer readings on the four exhaust connections differ by over 50 deg., although the valves and pistons are free of soot, which I take it means that combustion is good in all cylinders. Why the temperature difference?* E.K.

The variation may be due to one or more of the pyrometer plugs becoming sooted so badly that they give erroneous readings. Try cleaning all of them.

EVAPORATION WITH FIRE-TUBE BOILER—*We have a 78x18 ft. return tubular boiler hand-fired, using Kentucky coal costing $2.90 a ton. We evaporate 12.85 lb. of water per pound of coal. Feed water is 180 deg. F., steam pressure 100 lb. gage, and the per cent moisture is 9.3 per cent. Is this a good record?* M.L.

One should in these times be an optimist, but this evaporation seems too good to be true.

Kentucky coal ranges from 14,500 to 12,500 B.t.u., and the cost, $2.90 a ton, would lead one to suspect that the coal used is not the best. However, let us assume that it is 14,500-B.t.u. coal. There is also a question as to whether the 9.3 per cent moisture applies to the coal or to the quality of the steam, so calculations will be made both ways, first on the assumption that the steam is 9.3 per cent moisture.

To heat the feed water from 180 deg. to 338 deg. F., the temperature corresponding to 100 lb. gage dry steam, will call for the addition of 161 B.t.u. This heat necessary to add to the water at 338 deg. F. to evaporate a pound into dry steam at 100 lb. gage is 879.8 B.t.u. But as the steam is 9.3 per cent moisture, each pound of feed water needs $\frac{100\text{-}9.3}{100} \times 879.8 = 798$ B.t.u. to form steam that is 9.3 per cent wet. Each pound of feed at 180 deg. F. then requires $161 + 798 = 959$ B.t.u.

If the combustion were perfect and all the heat of combustion were recovered the evaporation would be $14{,}500 \div 959 = 15.1$ lb., so you would be obtaining an efficiency of $12.85 \div 15.1 = 85$ per cent, much too good for hand firing.

Now if the coal contains 9.3 per cent moisture, the available B.t.u. will be $14{,}500 \times \frac{100 - 9.3}{100} = 13{,}151$. If the steam is dry, then each pound requires $161 + 879.8 = 1{,}040.8$ B.t.u. Evaporation with 100 per cent efficiency would be $13{,}151 \div 1{,}040.8 = 12.6$ lb. So you would be obtaining over 100 per cent if you evaporated 12.85 lb.

SETTING DUPLEX PUMP VALVES—*How should one go about setting the steam valves of a duplex pump?* C.A.R.

Duplex pump valves have no lap, so the proper method is to place the two rocker arms connecting the piston rods to the valve gear in a vertical position, which puts the two pistons at mid-stroke position. Now adjust the valve rods until the two steam valves are in mid-position. The adjusting nuts on the valve rod should then be turned until the last motion is the same for both ends of the valve.

PIPE COLOR PLAN—*What colors are used in distinguishing piping containing various fluids?* M.M'D.

Various color cards have been issued by paint manufacturers. One system in general use distinguishes fluids by painting the pipe covering as follows:

High-pressure steam	Yellow
100-lb. steam, superheated	Canary
100-lb. steam, saturated	Colonial
Condensate	Salmon
Circulating water, raw	Pea green
Heated water	Moss green
Waste lines	Aluminum
Air lines	Gray
Fire lines	Red

PREVIOUS QUESTION DISCUSSED BY READERS

THE QUESTION

IS THE load due to warming up a building in the morning so much greater than the running load that the choice of heating boiler capacity if based on the latter will be too small? P.R.

AS THE NORMAL load is considerably less than the design load, the most economical boiler installation for space heating steam results when the nominal boiler capacity is considerably less than the maximum requirements.

The boiler size in question will in all probability be large enough, if chosen on the running capacity and providing the capacity requires one of the larger sizes of steel heating boilers capable of operating at 200 per cent of rating.

Space limitations often prevent a boiler setting that will permit the boiler to exceed its rated capacity. Under such circumstances a warming-up factor is required, that is, a factor by which the estimated load is multiplied in determining the estimated maximum load. This factor depends upon the time permitted for completely heating all the piping and radiation to operating temperature. The shorter the time the greater the boiler output required.

If analysis of the warming-up load shows that the heat emission of the radiation to be 360 B.t.u. per square foot per hour, the total heat supplied by the boiler during the warming-up period will be 360/240 or 1.5 (heating-up factor) times as much heat as required during the running load. If over two hours are permitted for warming up with cast-iron radiation the warming-up factor decreases to below one and the boiler is subject to no overload from this cause.

The morning warming-up load often involves other than estimated losses, and some of these losses are difficult, if not impossible, to predetermine. One of these losses, rarely provided for and often mounting to considerable proportions, is the heat absorbed by the materials stored in a building, such as stock, machinery, etc. If no provision is made for this absorption loss, when

the building is heating up these materials will absorb heat units that were intended for other work. The heat gains from electric motors and lights and occupants often do much to offset this loss during business hours, but during the heating-up period are not available.

As the business essentials of occupants may vary the warming load, it may be considered good practice in occupied buildings to choose a boiler a little larger than the one whose rating seems just about right for the maximum load, unless the time for warming up is so extended that this factor may be neglected.

Determination of boiler size should follow closely the recommendation of a reputable manufacturer who has been made fully acquainted with all the variables of the installation. It is to his interest to guarantee only a capacity that will best combine the variables, so as to carry out the desire for an economical installation.

WILLIAM ANDERSON.
Brooklyn, N. Y.

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IF A HEATING boiler is chosen to supply only the running load, or, in other words, the heat required to maintain a temperature of 70 deg. inside the building when the temperature outside the building is zero, this same boiler would ordinarily be too small to supply the additional heat required for the warming-up period. The additional boiler capacity required to satisfy these conditions would depend on:

1. Time allowed for the warming up period.
2. Occupancy.
3. Type of building construction.
4. Contents of building and its specific heat.

However, in small heating installations the warming-up load is usually comparatively small and the boiler chosen for the running load will be large enough to supply the additional heat required for warming up.

Fitchburg, Mass. E. W. SHAFER.

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THE MAXIMUM LOAD on a heating boiler occurs when it must heat a cold system during zero weather. At this time steam is in direct contact with the cold surface of the pipes and radiators making up the system, and condensation is extremely rapid. Even after the heating system has become hot, the load is heavier than normal, as the temperature difference between the radiator and the surrounding air is greater than that existing after the room has warmed up.

Before the capacity of a boiler for a given heating system can be determined, the maximum load the boiler will have to supply should be estimated. The following items should be taken into consideration: (*a*) the estimated heat emission in B.t.u. per hour from the connected radiators; (*b*) the estimated heat in B.t.u. per hour required to supply water heaters or other apparatus connected to the boiler; (*c*) the heat emission in B.t.u. per hour from the piping connecting the radiators and other apparatus with the boiler; and (*d*) the estimated increase in normal load due to starting up cold radiation.

The American Society of Heating & Ventilating Engineers, in its code on minimum requirements, gives the following percentages for use in calculating the load due to starting up cold radiation. For heating systems requiring 200,000 to 600,000 B.t.u. per hour, 55 per cent should be added to the estimated load. In systems requiring over 1,800,000 B.t.u. per hour, the estimated load should be increased by 40 per cent.

R. P. BROCKNER.
New York.

A Question for Our Readers

THE NEGATIVE exciting circuit collector ring on a 5,600-hp., 514-r.p.m, 60-cycle synchronous motor in an electrolytic zinc plant, plates the copper from the carbon-copper composition brushes on the ring, causing serious sparking and heating and often entails a shutdown of the unit to regrind the ring. Continuous sandpapering and wiping does not seem to do any good once the plating process has started. The ring is 1$\frac{5}{16}$ in. wide and 48 in. in circumference. There are six 1$\frac{1}{4}$ x $\frac{3}{4}$-in. brushes to each ring spaced around about one-third of the circumference of each ring. Exciter voltage is 125 and the current 185 amp. Carbon brushes do not do as well as the present type in use. Will some of POWER*'s readers suggest a cure for the trouble?* E.C.C.

Suitable answers from readers will be paid for[1] and published in the March 17 number

[1]Instead of cash payment for answers published, readers may select any one of the following books. (Be sure to state the book desired.)

Morrison's *American Diesel Engines;* Walker and Crocker's *Piping Handbook;* Norris and Therkeisen's *Heat Power;* Emswiler's *Thermodynamics;* Church's *Steam Turbines;* Uehling's *Heat Loss Analysis;* Croft's *Steam Power Plant Auxiliaries and Accessories;* Powell's *Boiler Feed Water Purification;* Osborne's *Power Plant Lubrication;* Moyer and Fittz' *Refrigeration;* Rietschel-Brabbee's *Heating and Ventilation;* Annett's *Electric Elevators.*

THE HEATING load in the morning is greater than the running load, because when the boiler is banked or shut down at night the floor, roof, walls, structural steel, piping, radiators and glass all cool down, and there is no heat being put into the building to make up the loss through the floor, roof, walls, windows and the natural infiltration of air.

Therefore, it is improper to figure boiler capacity based on running load, unless it is intended to operate the heating plant 24 hr. per day.

I had an experience recently that will illustrate the point. Two boilers were installed in a furniture warehouse. One boiler was designed to carry the load at any time, in zero weather, based on 24-hr. operation. The fuel used was oil. Operation did not bear out the design. Every morning the building was cold, and two boilers had to be operated at rating for three hours before a comfortable temperature was reached. A close investigation disclosed the fact that the night man turned the burners off when he came on duty so that he could sleep during the night. An alarm clock awoke him in the morning at 7 o'clock, at which time he would turn on the burners, and the load was so great, due to the cooling of the building during the night, that it was between 10 and 11 a.m. before the comfort zone was reached.

G. W. DAHM.
Astoria, L. I.

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IN BUILDINGS without night heating, the running load is far below the starting load in the morning. In one of the buildings served by our plant, 70 deg. is maintained only from 8 a.m. to 6 p.m., and allowed to drop ten degrees during the night and more over the week-end. On Monday morning, with 32 deg. outdoor temperature, steam is on full for four hours in order to reach 70 deg. by 8 a.m., and during the day the steam can be shut off 20 to 25 min. out of every hour and 70 deg. still be maintained, and not over two-thirds of the total radiation is on at any one time after 9 a.m. This shows that the running load is fully one-third less than the warming-up load in buildings where ample radiation is provided.

The difference, however, is not so great in a building where the radiation is too scant, for the reason that the warming-up period is of longer duration. For instance, if 10 per cent of the total radiation is removed uniformly throughout the building, the peak load is reduced 10 per cent, but the use of steam for longer hours will increase the fuel consumption, while permitting a smaller boiler capacity. In our plant the boiler size is such that at 125 per cent rating the warming-up load is carried easily. For hand firing the boiler should be large enough so that it is never operated above 150 per cent rating even in zero weather. Oil firing or stokers will, of course, permit a smaller boiler to be selected.

A. F. SHEEHAN.
Springfield, Mass.

THE ENGINEER'S BO

Courageous Thermodynamics

PRINCIPLES OF ENGINEERING THERMODYNAMICS. *By Paul J. Kiefer, professor of mechanical engineering, United States Naval Postgraduate School, and Milton C. Stuart, professor of experimental mechanical engineering, Lehigh University. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City; 1930. Cloth, 6x9 in.; 545 pages; diagrams, charts and tables. Price, $4.50.*

Reviewed by

JOSEPH H. KEENAN

Stevens Institute of Technology

"ENTROPY may be regarded in terms of work obtainable per degree fall."

"Entropy is simply proportional to unavailable energy."

These apparently irreconcilable statements came from no less authorities than H. L. Callendar and G. A. Goodenough. Authors of lesser authority have introduced the second law and its offspring, entropy, to their bewildered readers in well-chosen phrases which were defective in information, but erudite in implication. The average engineer seems to have accepted entropy as the man in the street accepts relativity, as an awe-inspiring truth. He hardly aspires to understand it, though he might compute available energies from a constant entropy line several times a month.

And yet despite the mystery which hovers about the second law of thermodynamics the reasoning used by Carnot in its proof was the sort of horse sense that should appeal to every engineer. Stuart and Kiefer have tried to make this point obvious. They have written a rather lengthy section dealing with the second law and entropy, both interesting and informative, and in these chapters many engineers will doubtless find for the first time the common sense of entropy.

The question naturally arises whether it pays the modern power engineer to be meticulous in his efforts to understand such fundamentals. He can obviously compute a constant entropy total heat drop without knowing the whys and wherefores of entropy. But there are more things in the modern power plant than were dreamed of in our fathers' philosophies. The formulas and methods that many of us learned in school have a disconcerting way of failing to meet the occasion when applied to the Benson process or even to the 1,400-lb. power plant. For instance, what sort of a process is the pumping of feed water to a Benson boiler and how much work must be done and how much heat added if feed-water heating is carried out between stages of compression? Our old assumption that heat put in is equal to the change in the liquid total heats found in the steam table does not work here. Any number of such problems might be posed and many engineers might answer them correctly, but many more would not. The difference lies in grasping fundamentals.

The method of teaching thermodynamics in engineering colleges fifteen years ago was simple and satisfactory, and any insistence on more precise analysis would have been mere pedantry. But a more difficult problem faces the teacher of today who must strive to plant firmly in the minds of the students the few basic fundamentals and have him work from those fundamentals in the solution of each problem.

This emphasis on precision has brought out certain difficulties and inconsistencies in the accepted vocabulary and methods. Frequently we have been guilty of defining heat and internal energy in almost identical phrasing and then insisting that they were two different things. We have called an important thermodynamic function total heat or heat content and then labored with our students to prove that we didn't mean it after all. Furthermore, we usually offered them a faulty explanation of its significance.

Kiefer and Stuart, in courageous fashion, have set out to right all these matters. Heat to them is not molecular agitation but energy in transition from a hot body to a cold body by virtue of the temperature difference. Total heat is not total heat but enthalpy, and the curse is taken off by pronouncing it en-thal'py to avoid confusing it with its famous associate.

Again, enthalpy is approached through the continuous-flow problem rather than through the heat put in at constant pressure, the latter procedure being both incorrect and unilluminating. The very arrangement of the book has emphasized what all engineers, but few authors of books on thermodynamics, seem to have known: that the steady-flow processes, as differentiated from non-flow processes, predominate in engineering. Perhaps the steady-flow energy equation is overworked when it is used to develop the expression for the force on a turbine wheel while good old Newton's law is merely mentioned. Nevertheless, it is better to have a correct attack, however circuitous, than the usual sleight-of-hand that passes in most turbine texts for a momentum analysis.

If Kiefer and Stuart have started a fight, let us rejoice. Whoever is the winner, the engineering profession cannot lose. Out of the controversy will come a more carefully organized and rationalized thermodynamics. If you wish to join the fight, or if you wish merely to acquire some thermodynamics in a highly useful form, you should read "Principles of Engineering Thermodynamics."

Smithsonian Report

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION—1929. *Printed by the United States Government Printing Office, Washington, D. C.; 1930. Cloth, 6x9 in.; 594 pages, illustrated. For sale by the Superintendent of Documents, Washington, D. C. Price, $1.75.*

IT IS CUSTOMARY for the Smithsonian Institution to include in its annual report a selection of from 20 to 30 articles, either original contributions or culled from the scientific periodicals of the world, giving a brief survey of the world's scientific progress. Always these articles are readable and interesting, serving as an annual re-orientation for those who, like the engineer, are too deeply buried in the day's task to find time for wide reading. And occasionally one of these articles stands out as of first rate interest to the engineer.

The latest Smithsonian report contains an article of this type. Carl W. Mitman, who is curator of the Divisions of Mineral and Mechanical Technology of the United States National Museum, has contributed a well illustrated article of over 50 pages on "The Mechanical Transport Era in the United States." This is an historical account of the development of power and its application. Tracing the early experiments with steam up to Newcomen's time, Mitman tells how one of Newcomen's assistants, Jonathan Hornblower, built a steam engine to operate a pump at Schuyler's copper mine in what is now Newark, N. J.

This first American engine was successfully operated by Josiah, a brother of Jonathan Hornblower, in 1755, more than a year after it had been shipped from England. Power dates its progress here from that day.

Following the account of this beginning, the author details the work of Fitch, Rumsey, Stevens and Fulton in the application of power to boats, and of Evans, Stevens and Baldwin to land transportation. Soon after these developments came the refinements of design that made commercial application feasible, and fast on the heels of this came the true beginnings of the mechanical engineering profession. Mitman shows how, in the relatively short time since then, power applications have been extended to include the perfection of steam machinery and the development of electric and internal combustion engine.

The remaining 23 articles included in the report cover a wide range of scientific advance, including astronomy,

BOOKSHELF

physics, chemistry, geography, biology, ethnology, zoology and archeology. The engineer who procures this report will find both entertainment and profit in its reading.

Reviewed by G. L. MONTGOMERY.

The Story of Electricity

AMBER TO AMPERES. *By Ernest Greenwood. Published by Harper & Brothers, 49 East 33rd St., New York City; 1931. Cloth, 6½x9½ in.; 332 pages, illustrated. Price, $4.*

WHO DISCOVERED static electricity or when the properties of the lodestone were first identified will probably never be known with certainty, but they both reach far back into antiquity. Insofar as known records go, the Greek philosopher and scientist Thales about 600 B.C. found that amber when rubbed by cloth developed the property to attract small bits of material. This discovery is accredited as being the beginning of our knowledge of electricity. The properties of the lodestone was known to the ancient Chinese and to the Greek philosophers. It was a long time from these early discoveries before amperes were transmitted through wires, and in this period there were many interesting events that had an influence upon the progress of electrical development. It is these that are outlined in this book and thus its title "Amber to Amperes."

The author has not attempted to give a detailed history of electricity and magnetism, but has endeavored to present the historical and social background of each important event in that history and give an account of the chief personalities involved. The first part of the book is devoted to the early periods when electrical and magnetic phenomena were a curiosity. In the early part of this period, philosophy and science made rapid strides, particularly with the Greeks. Then there followed a series of events that destroyed practically all this, and it required nearly 1,500 years to pick up the threads and again begin weaving the fabric of knowledge upon which our modern civilization is founded.

Among those who played a part in this are: Dr. William Gilbert the founder of magnetic and electric science; Otto von Guerick who constructed the first frictional electrical machine; Bishop von Kleist who discovered the lyden jar; Benjamin Franklin noted for his experiments with lightning; Alexandro Volta and his voltaic pile; Sir Humphrey Davy, with whom electric lighting may be said to have had its beginning, and Michael Faraday who's discovery of the principle of magnetic induction made possible the conversion of mechanical forms of energy into electrical energy and modern power systems with all the benefits that they have brought. Then came the work of building theory into practical machines and systems, with which the names of Edison, Morse, Bell, Marconi and many others are associated. Around these men and the social consequences of these developments, the author has woven an exceedingly interesting story.

The book is easy to read and may be comprehended by laymen as well as those who are technically trained. It will take its place among the many popular scientific books that have enjoyed lately a wide reader clientele.

Turbine Construction

THE MODERN STEAM TURBINE. *By E. A. Kraft. Published by VDI-Verlag, G.M.B.H., Dorotheenstr. 40, Berlin N.W. 7, Germany; 1930. Cloth, 8x10½ in.; 201 pages, illustrated. Price, RM 7.50.*

DR. ING. E. A. KRAFT is honorary professor at the Charlottenburg Technical University and director of the A. E. G. turbine works in Berlin. He is therefore well qualified to write with authority on steam turbines.

The book is confined to the latest tendencies in turbine construction and does not deal with either the theory or the general design of the turbine. There are no complicated formulas in the book, which is a critical survey, founded on practical experience, of the most important problems in the turbine industry.

The important chapters are: "Methods of Attaining Higher Economy"; "Technical Factors Limiting Design," which is a discussion of turbine materials; "Practical Application of the Principles of Design"; and a chapter on condensers and auxiliaries. The book is published in both English and German.

Brief Reviews

MECHANICAL WORLD YEAR BOOK. Compiled and published by Emmott & Company, Ltd., 65 King St., Manchester, England. 1931 edition; 358 pages, illustrated, tables; price, 1/6 net. —New features of this ever useful handbook include rewritten and enlarged sections on steam boilers, internal combustion engines, belt conveyors, hydraulics and gears. Many lengthy calculations have been eliminated, and the information is presented in a concise form for practical use.

CENSUS OF ELECTRICAL INDUSTRIES, 1927: CENTRAL ELECTRIC LIGHT AND POWER STATIONS. Compiled by the Bureau of the Census, United States Department of Commerce; 92 pages, charts and tables. For sale by the Superintendent of Documents, Washington, D. C.; price, 20c.—This booklet depicts the enormous growth of the power industry from 1902 to 1927. It is filled with tabulated information on every phase of central station expansion and contains an interesting summary of technical developments written by George F. Wittig.

SOURCES OF COAL AND TYPES OF STOKERS AND BURNERS USED BY ELECTRIC PUBLIC UTILITY POWER PLANTS. By William Harvey Young. Published by the Brookings Institution, Washington, D. C.; 79 pages, charts and tables; price, 50c.—This report of the Institute of Economics of the Brookings Institution was prepared in co-operation with the United States Geological Survey and shows the extent and location of the utility coal market, the factors determining the choice of stoker or pulverized coal burner and sources of coal used in central stations.

THE BONBRIGHT SURVEY OF ELECTRIC POWER AND LIGHT COMPANIES OF THE UNITED STATES. Seventh Edition. Edited by George F. Wittig. Published by the McGraw-Hill Publishing Company, 10th Ave. and 36th St., New York City; 193 pages, charts and tables; price, $10.—A geographical survey of the electric light and power utilities, which includes statistics on the number of customers, physical properties and financial structure of operating companies, management organizations and holding corporations.

A SURVEY OF STATE LAWS ON PUBLIC UTILITY COMMISSION REGULATION IN THE UNITED STATES. Compiled and published by Bonbright & Company, 25 Nassau St., New York City; 23 pages, 1 chart.—An analysis of the principal powers and jurisdiction of state public utility regulatory commissions. Included with the booklet is the Bonbright utility regulation chart, which shows at a glance the more important laws pertaining to the regulation of public utilities.

FORSCHUNGSARBEITEN AUF DEM GEBIETE DES INGENIEURWESENS, VOL. 338. Published by the V.D.I.-Verlag, 40 Dorotheenstr., Berlin NW 7, Germany. 30 pages, illustrated; price, 5.50 RM.—Contains the results of a study by Dr.-Ing. Hugo Richter to determine the loss of head in smooth bent pipes.

New Equipment Featured At A.I.E.E. Convention

An unusually large number of new developments are taking place in the electrical power field. This was evident by the character of the papers presented at the American Institute of Electrical Engineers' winter convention. These papers covered such subjects as a lightning protector for insulators, experiences with a new lightning arrester, new types of high-voltage circuit breakers, the use of electron tubes in industry, new application of automatic regulators, new type of synchronous motors, new systems of electric welding, and other new equipment

FOR FIVE DAYS, Jan. 26 to 30, the American Institute of Electrical Engineers held its winter convention in the Engineering Societies Building, New York City. President W. S. Lee opened the convention with an address, "The Engineer's Duty to Himself and the Public." After summarizing the work of the engineer in the design construction and operation of great projects, the speaker said:

"It is an ideal of the Institute that the engineer should endeavor to assist the public to a fair and correct general understanding of engineering needs: to ascertain the general knowledge of engineering; and to discourage the appearance of untrue, unfair or exaggerated statements on engineering subjects in legislation, the press, or elsewhere, especially if these statements may lead to, or are made for the purpose of, inducing the public to participate in unworthy or unsound enterprises or operations.

"If the engineer is capable of designing, constructing and operating these projects he certainly should be taken into the confidence of the public for the assistance he could give in advising it what the policy should be regarding these developments that play so important a part in the growth and well-being of our country."

It was Mr. Lee's opinion that this country is suffering from too much political engineering, political banking, political railroading, etc. As a concrete example of this he cited the Muscle Shoals development, and requested that engineers use their best efforts to see that the public is correctly and properly advised on engineering projects, for when so advised their conclusions will be sound.

At the ten technical sessions 50 papers on a wide variety of electrical engineering subjects were presented and discussed. A feature of this year's papers was the large amount of new developments described. Among these was a lightning protector for insulators; several new types of high-voltage circuit breakers; the application of helical grooves to slip rings and commutators; commutation and current collection in hydrogen; synchronous motors with phase-connected damper windings; a new electric welding system; and others. In addition there were many other papers of interest to power engineers.

Protective Devices Session

At the session on protective devices J. J. Torok described a lightning protector for insulators. This device consists, essentially, of a non-conducting small-bore tube with metal electrodes fixed on each end. With the application of sufficient voltage across the electrodes, the air within the tube breaks down and the voltage is rapidly reduced to normal arc value. From that point on the operation is similar to an explosion fuse, that is, at the end of the half cycle when the current goes through zero the arc is extinguished.

The results of field tests made on station-type Thyrite lightning arresters, of various ratings, connected to a 45-mi. line, using artificial lightning of 1,500,000 volts, were given by K. B. McEachron and E. J. Wade. Volt-time curves for arresters of various ratings were obtained under conditions corresponding to the arrester on each of two incoming circuits, on the bus with two incoming circuits and on the bus with one incoming circuit and one outgoing circuit. It was demonstrated that the calculated results agree closely with those obtained by test, so that the performance of arresters of the Thyrite type may be closely predicted.

Types of Circuit Breakers

J. B. MacNeill in his paper "The Trends in Development of Modern Circuit Interrupters" gave a description of the various devices that have been developed for the interruption of high-power, high-voltage circuits. These devices include Deion-type air breakers, compressed-air circuit breakers, live pot circuit interrupters using water, vacuum-type breakers, breakers with tanks containing resistance liquid, oil circuit breakers and oil circuit breakers with Deion grids.

An analysis of circuit rupturing ideas now before the industry justifies, in Mr. MacNeil's opinion, the following conclusions:

1. Several ingenious and rather well-developed devices which do not use oil as a rupturing medium are fast becoming available for commercial use.
2. All of these devices, while possessing good arc-rupturing characteristics, are subject to the limitations of available insulating materials. Their application to high-voltage systems makes difficult the problem of co-ordinating the impulse values of lines and apparatus.
3. For reasons of insulation and difficulty of operation in unfavorable locations, conservative engineering would seem to limit the use of these non-oil-filled breakers to voltages of 25 kv. and below, and for the most part to indoor service.
4. Other things being equal, preference will naturally be extended to that form of oilless circuit interrupter requiring no arc-rupturing medium, whether such medium be compressed gas, liquid or vacuum.
5. Improvements have been made in oil circuit breaker design which assist system stability and reduce arc energy, contact wear and breaker maintenance.
6. The growing requirements for ample insulation factors on high-voltage circuit breakers, after as well as before rupturing duty has been performed, to secure co-ordination of apparatus and line insulation on large systems, makes the use of oil in circuit interrupters extremely desirable for voltages above 25 kv., especially in outdoor service.

Oil Circuit Breaker Tests

Oil circuit breaker tests made at Philo station of the American Gas & Electric Company in 1930 showed that modern oil circuit breakers can interrupt short circuits several times without inspection. These tests were outlined in a paper by Philip Sporn and Harry P. St. Clair. Three groups of tests were made. In the first group 28 shots were made on a breaker equipped with standard butt-type explosion-chamber contacts. Inspection after the 28 shots revealed one of the explosion chambers shattered, with evidence, from the manner of the burning on the contact rod, that the breaker had been operated a number of times in that condition.

The second group of tests consisted of 40 shots on the same breaker equipped with the new oil-blast explosion chamber. The performance of the breaker was satisfactory throughout and all of the scheduled shots were taken, notwithstanding that on the last test a contact rod was lost through breakage of the crosshead.

The third group of tests was made with the same breaker equipped with the older type segmental contacts and explosion chamber. As in the tests on the standard butt-type contacts, inspection disclosed one of the explosion chambers shattered. This breaker, used in all the tests, had 60-in. tanks and was rated at 1,500,000 kva. The breaker on test ruptured as high as 1,735,000 kva.

It was pointed out that this experience will be useful in giving a greater degree of confidence in the ability of the plant and equipment to stand heavy short circuits, particularly since subsequent inspection of Philo generators showed no damage to any of the machines. It was the author's opinion that these and other tests should bring about the adoption of a new duty-cycle for oil circuit breaker performance. The multi-cycle is necessary, since breakers are frequently required to stand repeated shots during lightning storms. The Philo tests, in which the breaker operated through a long series of shots, without intermediate inspection or changes of oil, indicate that a multi-duty cycle is practicable.

R. M. Spurck and H. E. Strang, in their paper "Circuit-Breaker Field Tests on Standard and Oil-Blast Explosion-Chamber Oil Circuit Breakers," which also dealt with the Philo tests, said in their conclusions:

"A high-voltage high-capacity breaker has now been demonstrated to have the ability to interrupt 40 short circuits up to 115 per cent of its rating in a short period of time without inspection or attention and still be in condition to operate. This would indicate that the general impression of an oil circuit breaker as an unreliable device, and one requiring undue maintenance, may in some respects be subject to revision. Such a development appears to meet the requirements set up only a few years ago by some operating engineers for a breaker that could operate 50 times under short circuits without requiring attention."

Oil-Blast Circuit Breaker

The principle of the oil-blast circuit breaker such as used in the second group of Philo tests was described in a paper by D. C. Prince and W. F. Skeats. In this breaker the arc products are swept away by the scavenging action of an oil blast. A scavenging blast of oil is driven by the gas pressure from one break and displaces the arc in the space between the electrodes of another break.

In the discussion a type of oil breaker was described, by W. S. Edsall, that uses a number of horn-gap type contacts in series and a blowout coil of one or two turns to blow the arc out on the horn tip, where it is ruptured. This breaker is designed to meet the conditions on modern large high-voltage systems.

The opinion was expressed that the tests made on oil-type circuit breakers should increase the respect for this equipment and counteract the criticism made of it a few years ago. Developments in oilless types of circuit breakers at the present time do not offer any great encouragement for the application of this equipment on voltages above 25 kv. and for indoor operation.

The effects of resistance inserted in series with generators during and after a short circuit to increase the transient stability limit was considered by R. C. Bergvall in his paper "Series-Resistance Method of Increasing Transient Stability Limit." The series resistance loads the machines during a fault and greatly reduces the normal tendency to overspeed. After the fault has been cleared the series resistance exerts a powerful influence in retarding excessive overswing by taking advantage of the low generator stored energy relative to that of the load center. It was shown that by using series resistance a typical hydro system can maintain synchronism through a three-phase fault with speeds of circuit breaker and relay operation now available.

A three-phase resistor normally short circuited by a circuit breaker and connected into the neutral of each generator provides the most desirable arrangement. The cost will generally be much lower than the combination of other measures commonly taken, such as high-inertia generators, low reactance of generators and transformers, damper windings, transformer-neutral impedance, special simultaneous relay schemes, lightning proof lines, etc.; and the expenditure can be deferred until it is justified by operating experience.

Electron Tubes in Industry

At the session on industrial power applications five papers were read. The first, "Electron Tubes in Industry," presented the fundamentals of operation and the practical aspects of the application of some of the more important of these interesting devices. The applications include smoke-density measurements, high-temperature measurements, sign-lighting control, automatic counting, control of elevator doors, elevator control, recording and indicating light conditions, relaying applications, motor and other control application, rectifying alternating-current into direct-current and changing direct-current into alternating-current.

With Thyratrons at present available for industrial use it is possible to supply armature power for direct-current motors up to 5 hp. at 230 volts and motor-field excitation up to 5 kw., 230 volts. The direct-current voltage of the Thyratrons may be easily controlled over a wide range and thus the speed of the motor is adjusted.

It was pointed out that many additional possibilities for industrial application of these devices are open to consideration from an engineering and economic viewpoint. The Thyratron should be given consideration wherever relatively small power of adjustable voltage direct current are required, and should be given special consideration when automatic control of such voltage is desired in response to mechanical movements or electrical functions.

Automatic Regulators

Automatic regulation of voltage, power factor, speed, power output or input has come into wide use. Types of automatic regulators and their use in industry were discussed in a paper by J. H. Ashbaugh. Any particular regulator design can usually be used for different applications; a voltage regulator can be used for speed or current regulation or for other purposes. Regulators can be used to either improve the quality of the manufactured product, reduce the cost, simplify the operation, reduce the amount or size of the equipment or reduce the cost of purchased power. Load regulators accomplish the latter, and can be used in different ways enabling the industrial plant to make a substantial saving in operating cost.

There has been great need for a speed controller, one of the most difficult phases of regulation. Numerous speed regulators have been made, but, in Mr. Ashbaugh's opinion, a carbon-pile regulator described in the paper probably meets the ideal better than any other device, especially when considered in the light of universal application, speed of response, negligible maintenance and sturdiness.

Attention was called to the most recent trend in regulator design toward the use of electron tubes. They offer great possibilities in the elimination of moving parts and greater sensitivity. There are many problems concerning their use which must be overcome, and upon their solution depends the rate at which they will be accepted in industries. It is felt that rapid strides will be made along this line in the next few years, but at the present time caution must be exercised in their use and application.

Discussing this paper, R. G. Standerwick called attention to the close speed regulation that could be maintained with hydraulic-type regulators. There are in operation in industrial plants turbines, bleeding at two intermediate pressures and exhausting to vacuum to supply fluctuating demands for steam and electric power, whose speed, on load changes, does not vary more than one or two revolutions momentarily. In addition, the intermediate pressures are held constant. Mention was made of a 4,000-kw., 3,000-r.p.m. turbine-generator that is used for emergency service. Starting cold from the first indication that the unit is required on the system, the machine is up to full speed in 5 sec. and under load in 13 sec. by automatic control.

Electrical Distribution Systems

A paper, "Electrical Distribution Systems for Industrial Plants," by Walter J. McClain, indicated a method of compiling distribution problems, and to determine by an analysis of these a solution embodying the general requirements for an electrical system serving industrial plants. The scope of the paper included the distribution from the power house to the power-consuming devices, which are to have their electrical characteristics consistent with the power distribution determined, or as otherwise provided. The planning of a distribution system as advocated, divides under two headings: (1) Determining electrical characteristics; and (2) physical arrangement of the distribution. However, so far as these headings affect one another, often an interrelated digression is necessarily made. The paper accen-

tuated quality of service required and consistent economy.

Considerable progress has been made in recent years in the application of low-speed synchronous motors to industrial loads requiring both high starting torque and high pull-in torque with moderate starting current. The problems encountered, exemplified in the drives of grinding machinery in the cement and mining industries, to which several different applications of synchronous motors have been made, were discussed by M. A. Hyde, Jr., in a paper, "Synchronous Motor with Phase-Connected Damper Windings for High-Torque Loads."

A form of synchronous motor with a phase-connected damper winding has been devised for this type of service that develops a high torque with low kilovolt-ampere input. This motor is of salient-pole construction, with the desirable operating features of that type. Starting characteristics resembling those of the slip-ring induction motor are attained through the use of a special form of damper winding in which the bars are of low resistance and instead of being joined to end rings to form the usual cage construction are phase-connected and brought out through slip rings to an external starting resistor which is varied by suitable control.

Synchronous Motors Designed for High Torque

A 300-hp., 164-r.p.m., 100 per cent power factor, 2,200-volt, 3-phase, 60-cycle synchronous motor of this type developed 122 per cent pull-in torque at 5 per cent slip, and with 30 per cent damper resistance the starting torque was 230 per cent, and the corresponding locked kilovolt-amperes 396 per cent. With 15 per cent damper resistance the starting torque was 169 per cent and the corresponding locked kilovolt-amperes 280 per cent. The pull-out torque of this motor was 234 per cent of full load value.

A 350-hp., 400-r.p.m., 80 per cent power factor synchronous motor driving a centrifugal-type rock grinder developed a pull-in torque at 5 per cent slip of 118 per cent and a starting torque of 190 per cent, with 25 per cent damper resistance. When the damper resistance was made 40 per cent, the starting torque was 152 per cent, with 166 per cent starting kilovolt-amperes. This motor had a pull-out torque of 210 per cent full-load value.

In a paper entitled "Synchronous Motors Design and Application to Meet Special Requirements," D. W. McLenegan and A.G. Ferriss reviewed the characteristics of salient-pole synchronous motors. It was their opinion that the salient-pole motor with squirrel-cage amortisseur windings has advantages over other types that have led to the general adoption of this type as standard. The need for starting and pull-in torques greater than those of a normal motor occur most frequently in applying low-speed motors. For these motors there are six ways that these torques may be increased, namely: (1) Oversize high-torque motor, possible with double squirrel-cage rotor winding; (2) normal motor started on overvoltage; (3) delta-star starting; (4) normal motor started on tapped winding; (5) oversize motor with phase-connected starting winding and with salient or distributed pole-field windings; (6) the super-synchronous motor. It was suggested that in selecting a motor where high starting and pull-in torques are the main consideration the unity power factor machine is to be preferred. Where high pull-out torque is the governing factor it is better to use a leading power factor motor. This also applies if all the torques must be high. Where the motor is subject to heavy overloads momentarily it is advisable to have some means of forcing the fields during these periods.

Fraser Jeffrey, in a discussion on these papers, described a synchronous-induction motor for high-torque applications. The stator of this motor is the same as that of the conventional type. The rotor core is arranged for a distributed winding similar to the rotor of the wound-rotor motor. At starting the three-phase distributed winding is connected to an external resistor, as is that of a wound-rotor motor. When the motor comes up to speed, direct-current excitation is applied and it pulls into step and runs as a synchronous machine.

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Proposed Welded Vessel Code Discussed by A.S.M.E. and A.W.S.

Joint meeting of New York sections and code committee evokes expert comment

IN THE OPINION of many, welding moved ahead another step as the result of a meeting held in New York City on Jan. 22. Nearly 300 engineers, including some of the country's leading experts in the fields of welding and pressure vessels, attended the joint meeting of the New York Section of the American Welding Society and the American Society of Mechanical Engineers.

The subject was "Fusion Welding of Unfired Pressure Vessels," and the specific object of discussion, the "proposed specifications for fusion welding of unfired pressure vessels," as published in the December issue of *Mechanical Engineering*. This proposed specification is similar to the suggested specifications for welded boiler drums published in *Power*, March 25, 1930.

Several members of the A.S.M.E. Boiler Code Committee, including Fred R. Low, chairman; D. S. Jacobus, vice-chairman; C. W. Obert, honorary secretary; Edward R. Fisher, Vincent M. Frost, and H. Le Roy Whitney, were present to receive comments on the proposed code. All of them participated actively in the discussion, which was conducted under the guidance of Mr. Obert as chairman.

The meeting served not only to give the code committee the benefit of expert opinion on various code paragraphs and details, but also to review the varied relations of the A.S.M.E. Boiler Code Committee and welding proponents during the past ten years.

Viewpoint of Code Committee

It became clearly evident from the talks of various speakers that the friction and misunderstanding of earlier days between manufacturers and users of welding equipment on the one hand, and the Boiler Code Committee on the other, have been largely replaced by active co-operation to advance pressure-vessel and boiler welding along safe and sound lines. The code committee, through various spokesmen, clearly displayed its active interest in permitting expansion of pressure-vessel welding as rapidly as public safety will permit. Welding representatives, on the other hand, fully conceded the propriety of a reasonable conservatism on the part of the committee to avoid any public danger through the commercial application of loose welding methods.

In a general word of greeting, Mr. Low told of the great improvements in commercial boiler construction resulting directly from the application of the boiler code for riveted boiler construction. He pointed to fusion welding as a process which in the nature of things should be superior to riveting if proper safeguards can be set up for materials, methods and men. The question, said Mr. Low, is "How can we put into a code definitions, specifications, or formulas for welding joints that will protect the public yet not be too specific regarding the process of any one manufacturer or group of manufacturers, and not be wide open to incompetent operators or unsuitable equipment."

Referring to the many difficulties created by conflicting opinions in the past, Mr. Obert called on E. R. Fish, chairman of the sub-committee on unfired pressure vessels, to present the committee's viewpoint. Mr. Fish said that the proposed specification is in no sense a finished product, but merely a target to shoot at.

Good welding can undoubtedly be done, said Mr. Fish, but probably not by shops which have not prepared carefully for such work. He suggested that the proposed specifications may be too rigorous for many classes of commercial vessel, and that ultimately three grades of classification, say A, B and C, may be set up, according to the type of work. Thus, specifications for grade B and grade C jobs could be less burdensome.

Mr. Obert said that the final correction and publication of the code for fusion welding of unfired pressure vessels would still leave a gap to be covered in the range of vessels for intermediate service.

Perhaps the most dramatic presentation of the evening was that of Eric H. Ewertz, consulting welding engineer, past president of the American Welding Society and chairman of the Joint Pressure Vessel Committee. This committee, which now has fifty members, plays an essential rôle in crystallizing opinion and information on welded vessels for the Boiler Code Committee.

Ewertz Calls for Action

Mr. Ewertz spoke very frankly of "ten years of nagging," which, he said, was finally yielding results. About six or seven years ago a series of tests of welded pressure vessels were made, with results considered highly satisfactory by the American Welding Society. These were presented to the code committee, which judged them inadequate and asked for further evidence for welding. As a preliminary to the conduct of a second series, the Joint Pressure Vessel Committee was appointed, with Mr. Ewertz as chairman. The membership included members of both societies (A.S.M.E. and A.W.S.) and also others definitely interested in welding applications.

A very complete testing program, to cost approximately $50,000, was laid out by the Joint Pressure Vessel Committee and approved by the Boiler Code Committee. But, in spite of hearty co-operation by the manufacturers of equipment, this program fell through, because the tank manufacturers (the supposed beneficiaries of the work to be done) would not incur the expense of welding the necessary test drums. This setback threatened a serious situation. Shortly after, however, the Boiler Code Committee decided to modify the rules on its own initiative.

Mr. Ewertz referred to the proposed specifications for unfired pressure vessels as practically what had been hoped for if the research program had been carried out. Admitting the responsibility resting on the code committee, he said that conclusive evidence is now in hand that welding can be done under conditions that assure dependability, and that further delay in the promulgation of definite rules cannot be justified.

Where Welders Disagreed

Speaking for the code committee, Dr. Jacobus, vice-chairman, laid much of the blame for long delay on the welding interests involved. "In the early days," he said, "each welding advocate approached the committee to argue the perfection of his own process and the inadequacy of all others." As a result, the net weight of opinion presented to the committee by the welding interests themselves was always against welding.

On the constructive side, Dr. Jacobus referred to a special understanding between the code committee and the states of California and Oregon, whereby those states experimented with vessels welded according to the older code rules, but with modifications permitting more severe service and higher unit stresses. None of these vessels has failed, he said.

The Development of Procedure Control

Another speaker, a pioneer in the development and application of procedure control, was G. O. Carter, consulting engineer, Linde Air Products Company. This movement, Mr. Carter said, developed from work started by his company about ten years ago. First came a field study of good welding shops, which revealed the necessity of checking workmanship. There followed an inspection of the work of the late S. W. Miller, who showed that butt-joint welds uniformly stronger than the plates could be produced by welding from both sides and by using a deposited metal of higher quality than the base metal.

Following this welding was used to fabricate tanks for high pressures and dangerous fluids. The testing of these tanks developed weaknesses in manholes and heads of usual construction. Riveted joints would not have permitted sufficiently high test pressures to develop weaknesses thus revealed at knuckles of heads, at manholes, etc. As a result of this work new designs of manholes and heads were developed. None of these tanks has failed in service.

Proposed Code Is Discussed

After these introductory remarks, which gave the necessary background for intelligent comment, the proposed specifications were discussed paragraph by paragraph, and some of the more important conclusions will be summarized here. Harry E. Rockefeller, development engineer of the Linde Air Products Company, expressed the opinion that more attention should be given to testing the welder and less to testing plates for each vessel, since a single test plate would not prove the quality of the whole weld. A. A. Weigel felt that the test plate is necessary if only to check up on the quality of welding rods, which, he said, may vary from one shipment to the next.

Stress Relief Argued Pro and Con

Paragraph 4, requiring stress relieving of the whole structure at 1,100 deg. F., drew out much discussion. Mr. Obert pointed out that the heat-relieving of stress would probably be required for grade A vessels only. H. Le Roy Whitney, referred to stress release as an absolute essential for tanks subjected to corrosive substances, or any fluids at higher pressures and temperatures, since stresses promote corrosion. He felt, however, that tanks for less severe conditions might be satisfactory without stress release. Robert E. Kinkead, consulting engineer, Cleveland, Ohio, suggested that stress release might be accomplished without heating, by stretching the tank hydrostatically beyond its elastic limit.

J. R. Dawson said that many of the tests included were not well suited to routine checking. He objected to the tensile test of the weld metal (that is, of a coupon cut entirely out of the weld metal), since in 90 per cent of failures some other defect than poor weld metal, such as poor fusion or penetration, caused failure. He suggested elimination of the density and impact tests for routine acceptance.

Mr. Fish suggested the use of a tensile specimen cut across the weld, but with the narrow portion sufficiently short to insure necking and breaking in or near the weld, thus testing both the weld itself and its adherence to the parent metal. He referred favorably to the bend test.

Notched-Bar Test Condemned

The bend test, inserted in the proposed specification, is very largely an outgrowth of recent work by Mr. Kinzell of Union Carbide & Carbon Research Laboratories. He said that for satisfactory results the specimen should be at least three times as wide as it is thick. The proposed specification calls for a width of 1½ times the thickness. He suggested modifying the code to require three times the thickness, and on this basis to require a greater minimum elongation. Mr. Kinzell, later backed by Mr. Sheldon of the General Electric Company and others, condemned the notched-bar impact test as of little value in the present state of testing knowledge, giving inconsistent results incapable of correlation with operating results.

The operation and application of X-ray tests were discussed by H. R. Isenburger, industrial X-ray specialist, and by E. W. Page, of the General Electric X-Ray Corporation of Chicago.

Triple-Pressure Hydrostatic Test Penalizes Welding

Paragraph 12 of the proposed code requires a final hydrostatic test pressure three times the maximum allowable working stress. Mr. Rockefeller pointed out that while this imposes no undue strain upon the weld itself, it requires vessels to be designed with extra heavy heads, manholes, etc., thus imposing an unnecessary burden on welding. Illustrating this same point, Mr. Carter told of cases where it was necessary to increase tube sheet thickness from 7 to 11 in. to take care of the test pressure.

Mr. Frost, final speaker, asked why welders should object to tests, when today, after many years, every sheet of steel manufactured is tested.

Suggestions presented at the meeting will be considered by the Boiler Code Committee in the near future, it was announced.

Safety Rules for Power Plant Operators

By FREDERICK L. RAY

Superintendent, North Anderson Power Plant
Indiana Railroad

At a meeting of employees of the North Anderson power plant of the Indiana Railroad, Anderson, Ind., held the early part of January, Frederick L. Ray, superintendent of the plant, delivered an address in which he presented the following safety rules for station operators:

DON'T look at a glass gage, if under pressure, when turning on water or steam. If it should burst, there is danger that you will suffer the loss of an eye.

Don't look into a very hot fire without colored glasses; injury to your eyes may result.

Don't open a steam valve on boiler until pressure on both sides of the valve is equal; there is danger of water-hammer bursting the valve.

Don't look into a furnace door any more than necessary, for two reasons: first, a ruptured tube might burn you; second, it will cause waste of fuel.

Don't open a blow-off valve suddenly; a water-hammer may burst a fitting.

Don't go under a boiler until you know the ashes are cold; many a man has been burned by hot ashes.

Don't operate a boiler with a defective water column or steam gage; you may burn the boiler or have excessive pressure.

Don't tighten cap bolts with steam pressure on them. If they should break, you may be scalded.

Be careful when adjusting pop safety valves; don't hammer on them; the blow of the hammer may cause rupture of valve.

Don't go into a boiler without first making sure that all valves are closed and danger signs placed. If not, you may be scalded.

Don't go into an ashpit before placing danger signs on water column blow-out.

Don't work on a stoker shaft while in operation.

Don't go into a smoke tunnel or breeching without a helper.

Never take an extension electric light cord inside a boiler.

Turbines and Engines

Be sure that safety overspeed devices are in good order.

Be sure that oil pumps, both main and auxiliary, are in good order.

Will the governor control the speed of the turbine with the throttle wide open? Tests should be made every time the unit is taken out of service.

Remember that regular inspection every twenty minutes is absolutely essential to safe operation of steam turbines.

Don't climb on top of an engine while it is running; you may slip into the wheel or valve gear.

Don't try to clean a flywheel while it is running.

Be very careful in adjusting valve gears while in motion.

Keep the floor clean of oil about engines—save oil and prevent accidents.

Examine governor belts closely every time engine is down. Your life and perhaps many others may be in danger by a failure here.

Steam Fitting

Don't work on unsafe platforms. Whether they are hung or built up from the floor, always make them strong and secure.

Keep tools sharp and in good order. Many injuries are caused by wrenches slipping.

Don't leave tools on ladder, platform or any other elevated place, as they may fall and cause injury.

Take no chances with ropes or chains. See that they are strong enough to lift your load, and make no movement until you are sure everything is safe. Always be sure your hitch is safe.

Be very careful about tightening bolts and pipework under pressure; there may be a strain on the piping that your work would cause to break.

Coal and Ash Handling

Be sure to have a rope attached to your body before going down into ash bunkers. Men have been buried in ashes because of failure to do this.

Don't jump on or off moving cars.

Don't use an unsafe brake stick when moving cars.

Don't work over coal crusher while it is running; a fall would result in a terrible death.

In moving cars use the whistle freely to warn others of your movements.

Keep car movements under control at all times. Use the sand. Try the brakes. Make sure the air pressure is good.

Don't work under the boom or bucket of a coal crane. Be one guard lest the bucket swing and crush you.

Be very careful, in dropping car doors, that the wrench does not slip and injure you.

Don't work on elevator chains unless you know the motor switch is out and operator notified. Be sure safety sign is hung on switch.

Keep the guard rails on the walk over the coal bunker in good order.

Keep guards on the gears and warning signs in place.

Don't climb on top or over a conveyor while it is running. A slip or a catch in your clothes may cause you to lose your life.

General Rules

Keep clear of electric wires while working on a scaffold or other elevated place.

Don't go into wells or cisterns without first testing for gas and having a rope attached to the body.

Don't use a ladder unless you know it is perfectly safe. Always be sure the ladder is set at a safe angle, tied or fastened in some way so it won't slip and cause you to fall.

Be very careful in working on shafting. If your clothes should catch you may lose your life. Don't wear loose garments, gloves or rings about machinery.

Keep your shoe heels built up straight and guard against slipping. Slipping causes more accidents than any other one thing.

Don't climb a ladder with tools or material in your hands—you need both hands to climb. There is a better way to handle tools and material—they should be passed up or down with a rope.

Never try experiments with electricity or machinery; ask your foreman.

Don't play practical jokes or indulge in horseplay. Many deaths and serious accidents have been the result of this practice. "Jokes" in which an air hose figures almost always result in death to the victim.

Don't touch any electrical switch or device unless you thoroughly understand its use.

Don't leave remainder of lunches, rags or greasy overalls on steam pipes or floor. Cleanliness is most important.

Don't keep gasoline or explosive material in other than approved safety cans.

Don't keep machinery running when not needed.

Don't drop wet bearings or water in babbitt pot. If you do, an explosion will be the result.

Don't take a chance. Don't say, "It's good enough." There is only one way of doing work and that is "well." Don't say, "I guess so," or "I think so." State positively as to whether or not work is completed. You must know.

If you know of any tools or conditions that need repair or attention and that are really dangerous, go at once to the foreman and report it. If it is not then given attention as you think it should, report it to the superintendent.

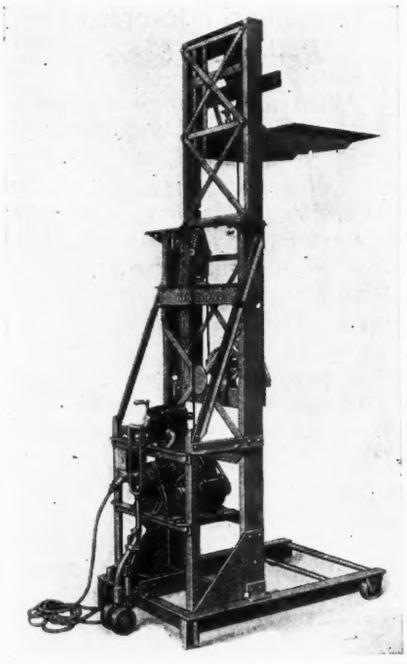
Don't neglect any wound or injury, even if slight. Report at once to the foreman and receive first-aid treatment. Prompt action may save your life.

WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Hand- and Motor-Operated Lifting Machines

A NEW LINE of ball-bearing-equipped lifting machines, both hand- and power-operated, plain and telecoping units, is now being put out by the Economy Engineering Company, 2653 West Van Buren St., Chicago, Ill. Ball bearings are used throughout the gearing, sheave and platform frame wheels, and also on the sliding frame wheels of the telescoping units. In the new hand-power type only 25 lb. cranking pressure is required to lift the load.



Ball-bearing-equipped electric telescoping unit

Spur-geared hoisting units are used exclusively, that of the hand-power being fully guarded and lubricated with grease. The electric unit is inclosed by a metal case and runs in a bath of oil. The former has a self-acting gravity brake, while the latter has a dual system, both brakes working automatically to hold the load wherever desired.

The electric machines are equipped with high-torque motors of $\frac{1}{2}$, 1, 2 or 3 hp. or more, depending on the speed of operation. All are controlled alike, unless otherwise specified, by a single-lever drum switch. A lever attached to the rear of the controller shaft operates the brake.

Automatic limit stops prevent overtravel of the platform by returning the control lever to "stop," halting the motor and setting the brake.

Some of the uses to which a machine of this type can be put in power and industrial plants are raising motors and other smaller pieces of equipment into position, and providing a scaffold for miscellaneous operations, such as tightening up flange joints on pipe lines, etc.

Electric Drill and Hammer

DRILLING up to $\frac{3}{8}$-in. holes in metal, $\frac{1}{2}$-in. holes in wood and $\frac{7}{8}$-in. holes in concrete or brick is possible with the light weight electric dual twist and hammer drill made by the Wodack Electrical Corporation, 4627 West Huron St., Chicago, Ill.

In addition to operating as a hammer it can be used as a rotary drill and also for grinding, scratching and buffing. The tool itself weighs only 12 lb. and the entire kit 20 lb. A bench stand as well as a convenient stand for use as an auxiliary drill press or bench grinder can be furnished.

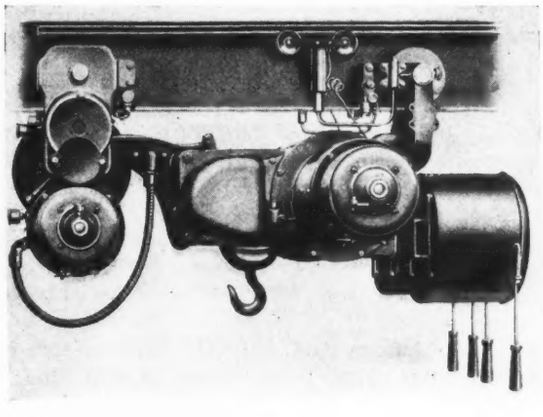
Dual twist and hammer drill

Motor-Operated Hoist and Motor-Driven Trolley

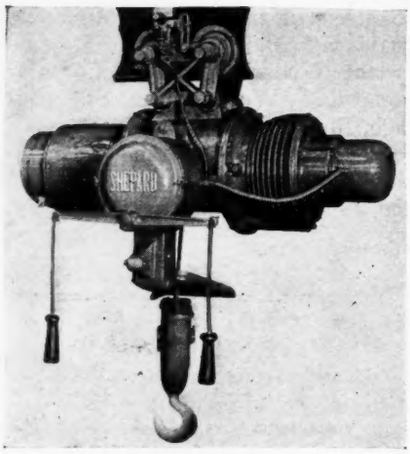
RECENT ADDITIONS to the line of cranes and hoists put out by the Shephard Niles Electric Crane & Hoist Corporation, 388 Schuyler Ave., Montour Falls, N. Y., are a "Compact Hoist" and an improved motor-driven trolley, as illustrated.

The hoist embodies sectionalized construction and interchangeable parts. By the use of the same hoist body piece and attaching different motor and gear-end sections varying requirements of speed and capacity can be met. The motors are especially designed for hoisting service and are of 30 min. 50 deg. F rating. All moving parts with gear end operate in an oil bath and all gears are of steel, heat-treated. A fully inclosed load block is used, except on the closed-clearance hoist. An electric brake and limit switch are employed.

The improved motor-driven trolley,



"Compact Hoist" and model 21 motor-driven trolley assembled as a unit

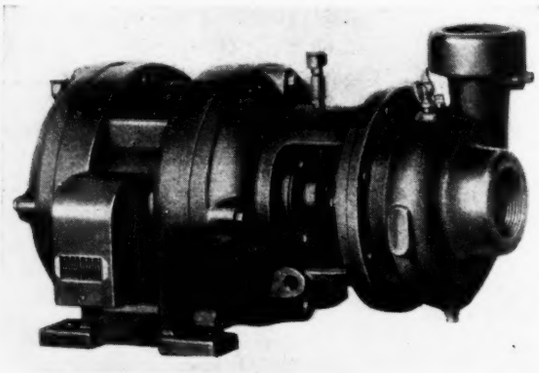


"Compact Hoist" of sectionalized construction

designated Model 21, was developed especially for propelling light-capacity hoists along their runways. It is of all steel construction and fitted with ball bearings throughout. The motor is mounted directly underneath trolley sides, and rotates about the center line. The trolley is designed to negotiate small-radius curves (3 ft. min.) and through narrow switches.

Pumping Units With Totally Inclosed Fan-Cooled Motors

AN EXTENSION to cover three new sizes in its line of "SSU" centrifugal pumping units of single-shaft, two-bearing design, which now



"SSU" centrifugal pumping unit with totally inclosed fan-cooled motor

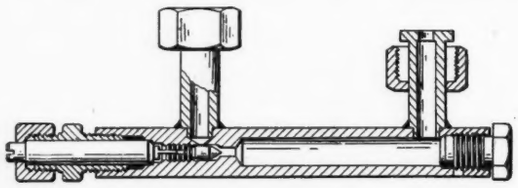
includes ratings from 30 to 500 g.p.m. for heads under 100 ft., is announced by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Recent adoption of total inclosure of motor housings on the pump end of these units, and totally inclosed fan-cooled motors, if necessary, permits their use for severe service conditions.

Some applications of "SSU" pumps are, water supply; circulation of water, oil or brine for heating or cooling systems; transfer of liquids; air conditioning; house service and auxiliary service to power equipment for cooling water seals, etc.

Damping U-Tube for Flow Meters and Controllers

A DAMPING U-TUBE for use on its new style flow meters and flow controllers is announced by the Foxboro Company, Foxboro, Mass.

This U-tube can be adjusted for proper damping while the instrument is in operation. A screw-driver extending through a packing gland is fitted to the end of a needle valve.



Foxboro damping U-tube for flow meters and controllers

By turning the screw driver at its outer end, adjustments can be made in the damping without the mercury being forced out.

The damping U-tube is not furnished as standard equipment but may be specified when ordering new meters or controllers. It is also available for installation on Foxboro flow meters or flow controllers now in use except types T, C, A and B.

Air-Break "Explosion-Proof" Motor Starter

AN AIR-BREAK "explosion-proof" motor starter, known as Type E, has been developed by the Louis Allis Company, Milwaukee, Wis. This starter is built to prevent the escape of flame from any explosion likely to occur inside the apparatus due to grounds and burn-

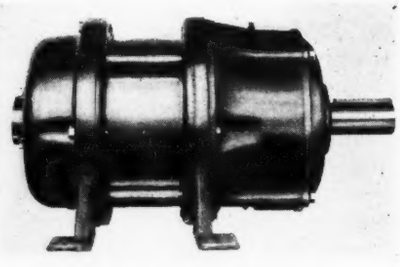
Nellan Type E explosion-proof starter

outs. The starter proper consists of the usual across-the-line, air-break, magnetic contactor with overload and undervoltage protection. Strength to withstand explosions is provided by a heavy cast-iron case.

Combined Motor and Reduction Gear

HELICAL-GEAR reduction units are built into the end shield of a standard electric motor to form front gear motors, a product of the Watson-Flagg Machine Company, 107 Nineteenth Ave., Paterson, N. J. Except for a slight increase in overall length, together with a larger shaft diameter than usual, because of the lower speed involved, the combination is practically the same in appearance as the motor alone. The wide-spread, double-bearing supports for the output shaft extension permit the application of these units on overhung load conditions.

The front gear motors are equipped with anti-friction bearings throughout, and are dust-proof and oil-tight. They are available for any speed motor from 3,600 r.p.m. down from $\frac{1}{6}$ to 30 horsepower.



Motor with reduction unit built in end shield

NEWS of the FIELD

Dr. Flinn Urges Research in "Humanics" To Eliminate Evils of Machine Age

Director of Engineering Foundation says engineer must help solve social problems created by new technology

RESEARCH IN "HUMANICS" to make the machine a blessing instead of a curse to mankind is advocated by Dr. Alfred D. Flinn, director of the Engineering Foundation. Engineers, having created the machine age, must lead the way in eliminating the hardships it has wrought, he declares in outlining plans for engineering research in 1931.

"It must soon cease to be possible for any person to say or think honestly that the great blessings of science and engineering are even temporarily a curse to himself or anyone else, because of the ways in which they are introduced into industry and business," Dr. Flinn asserts.

"It is not sufficient to aim our researches only at physical applications of the natural sciences. These worthy endeavors must be supplemented by earnest, effective investigations to guide our engineering organizations in helping to solve the grave sociological, governmental, and international problems created partly by the achievements of engineers.

"The energies of the engineering societies and their research foundation might profitably be directed to humanics: to adjustments in industry and business to prevent or reduce hardships brought about by great improvements in machines, processes, methods, or materials, displacing existing products, equipment, or plants, and affecting large numbers of persons; and to effects of engineering advancement upon government, international relations, legal practices, social organization and education.

"The four great national engineering societies, with an aggregate membership of nearly 65,000, which the foundation serves, are interested in both broad and special problems of technology and humanics. With the increasing complexity of civilized life and the engineer's multiplying responsibilities, his needs are no longer satisfied by physical research alone.

"Are those who truly create wealth receiving a just share in comparison with those who boast of 'making money' and of 'hiring engineers'? How can youngsters with engineering aptitudes be discovered early enough for their best individual training with least waste of years and dollars? How can graduates be placed in employment or launched into practice, to best advantage for all concerned?

"The American Society of Mechanical Engineers is starting a research, or survey, of its members, which is expected to yield facts that, when skilfully studied by the research men, will answer some of these questions with fair approximation. Other national societies are likely to undertake similar researches as soon as the technique shall have been developed by the pioneer.

"Fortunately the engineering societies already have an instrumentality that can serve them jointly in this province of humanics, the Engineering Foundation. The founder, Ambrose Swasey, and the wise men who aided him in setting it up, foresaw the human as well as the technical needs of engineers and therefore gave the Foundation a broad charter. Its functions comprise not alone 'the furtherance of research in science and engineering,' but also 'the advancement in any other manner of the good of mankind.' "

Public Ownership Bills Introduced in Wisconsin

TWO JOINT RESOLUTIONS providing for constitutional amendment and two bills for public ownership and operation of utilities have been introduced in the Wisconsin Legislature by Senator O. S. Loomis, according to a dispatch in the *United States Daily*.

The first constitutional amendment would allow the state to recapture water developments and to engage in the electrical business. It provides for control of power at its source and empowers the state to take advantage of the 1911 law and recapture its water power sites now held by private companies, although this could not be done until 1941. In the meantime, however, the state would be able to take over new sites.

The second constitutional amendment is identical with the one passed in 1929 and relates to the debt limitations of municipalities which want to go into the electrical business. It permits municipalities to purchase electrical generating and distribution systems without having to compute the cost or the indebtedness of the system as a part of their bonded indebtedness.

The two bills offered by Senator Loomis are the power district bill and the municipal competition bill.

The first provides for the creation of power districts comprising cities and villages and intervening territory which may generate, transmit, sell and distribute light, heat and power, and which can ultimately be hooked up with the state system when and if authority for the state system is given by the people.

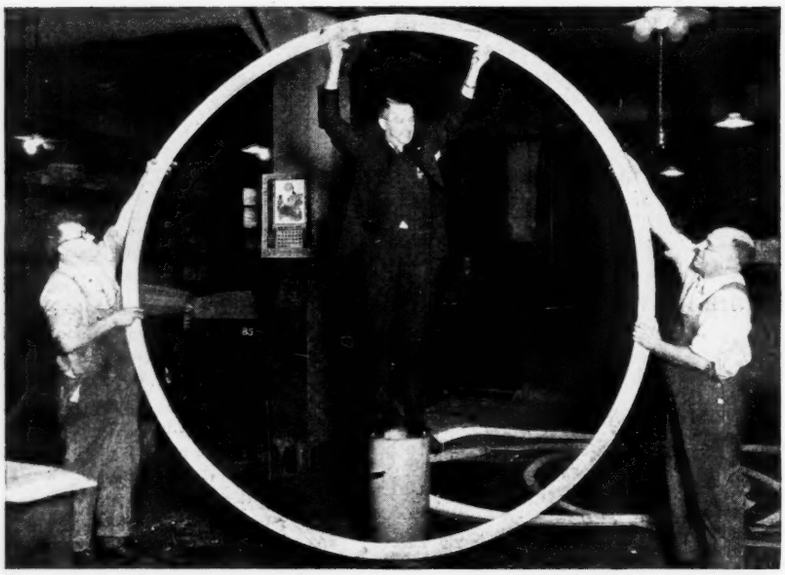
The municipal competition bill gives to cities and villages the right to compete with privately owned utilities now serving those communities. It does not give private concerns the right to start competition.

A.E.C. to Name Committee On Hydraulic Laboratory

A COMMITTEE of five members representing the American Engineering Council will be appointed by President C. E. Grunsky to watch the development of pending plans for the national hydraulic laboratory. Appointment of the special committee was authorized at the recent meeting of the assembly in order that the council might have some assurance that the laboratory is developed along lines of greatest usefulness. The personnel of the committee has not yet been selected.

Council's action follows the apparent failure of Dr. G. K. Burgess, director of the Bureau of Standards, to accept the recommendation of the bureau's advisory committee for adoption of John R. Freeman's plan for building and equipping the laboratory. The appropriation authorized for the project is $350,000. The advisory committee found that Freeman's plan would cost $351,000, but the bureau holds that this plan would involve expenditure of $420,000 if all essential facilities were included. The advisory committee is on record to the effect that if the Freeman plan is too costly it should be pruned to meet the limited funds available rather than discarded in its entirety.

WORLD'S LARGEST LEATHER PACKING



Believed to be the largest leather packing ever manufactured, this ring is one of a quantity made for one of the United States Government engineering projects by the Chicago Belting Company. It measures 8½ ft. in diameter, ⅜ in. thick, and is made of chrome leather

▼ ▼ ▼

Gas Plant to Produce Power, Ice, Fertilizer

PLANS for the production of power, ice and fertilizer, in addition to gasoline from the natural gas output of Kettleman Hills and Dudley Ridge oil fields were announced by the Dudley Ridge By-Products Company Jan. 26.

The company said it would erect a plant in the San Joaquin Valley to extract gasoline by absorption, burn the dry gas as fuel to generate electric power, manufacture dry ice and convert the residue into nitrate fertilizer.

The announcement said the plant would consume 50,000,000 cu.ft. of gas per day.

Power will be sold and distributed through electric companies. The ice is to be made through a new method of burning the gas by which hydrogen and carbon are conserved. The ice plant is to have a capacity of 500 tons a day.

California Commission Speeds Up Transactions

CALLING for a more expeditious handling of its business, resolutions have been adopted by the California Railroad Commission declaring that long-drawn-out rate or other proceedings will not meet with its approval, and more hearings will be held by commissioners. The resolution is as follows:

"Cases and proceedings shall be set for hearing promptly when at issue. In the absence of special circumstances, such as the necessity of engineering or technical investigations, hearings will be commenced within 30 days of the date matters are at issue.

"Continuances and postponements will not be looked upon with favor.

"The commission will revert to its early policy of having more matters heard by the commissioners themselves.

"In the absence of special circumstances decisions will be gotten out within 30 days of submission. Commissioners and examiners conducting hearings will be expected to prepare and submit orders within this time."

Seattle Light Dept. Seeks Control of Engineering

BY A VOTE OF 6 TO 2 the city council of Seattle, Wash., has refused to submit to the people at the city election to be held March 10 a proposed charter amendment to give the City Light Department jurisdiction over its own engineering work. The matter has been in controversy for some time, with the City Light Department urging that costly delays in the Skagit River power development have resulted as the lack of co-ordination between the city engineering department, which does the planning, and the light department.

The Citizens' Municipal Utilities Protective League plans to start circulation of referendum petitions to force a vote by the people on the question at the March election. The league declares that the city engineering department, judged by the way it has handled City Light construction work, is "either patently inefficient or deliberately obstructing the city light department's development work."

Councilman Otto A. Case, who supported the measure before the council, declared that failure to complete the power house at Diablo by the time the Diablo dam was ready for use cost the light department approximately $1,000,000 for fuel oil, an expense which, he claimed, would have been averted had the Diablo plant been completed on time.

A.S.R.E. Spring Meeting In Kansas City, May 6-8

THE SPRING MEETING of the American Society of Refrigerating Engineers will be held May 6, 7 and 8 at the Hotel President in Kansas City, Mo., a city offering many facilities for the inspection of refrigeration work. Subjects to be covered at the sessions will be of up-to-date concern for all refrigerating people. No previous meeting of the society has been held at a city so far west; members of the organization believe that the importance of the refrigeration industries in the Middle West will make this meeting especially interesting and significant.

Three morning sessions are to be scheduled, with entertainment of various kinds in the afternoons. A ladies' program is being arranged and wives of members are to be made welcome by the local committee. Plans are under way for the special transportation of Eastern members in a trip which will mean only one night on the road.

Pulverizer Sales Total 303 in 1930

SALES of pulverized-fuel equipment for power-plant installations in 1930 totaled 303 mills with a total capacity of 1,622 tons per hour, according to reports received by the United States Bureau of the Census from the eleven manufacturers which are believed to constitute the entire industry. The total rated horsepower of these installations amounted to 245,979.

Of the total sold 11 mills with a capacity of 184 tons per hour were of the central system, for installation under water-tube boilers in plants with a total rating of 24,176 hp. The balance, 292 mills of 1,438 tons per hour capacity, were of the unit system, for installation in plants with a total rating of 221,803 hp. Of the unit system, 249 mills with a total capacity of 1,365 tons per hour were for installation under water-tube boilers of 214,500 total horsepower; 28 mills of 63 tons per hour capacity were for installation under fire-tube boilers of 4,753 hp., and 15 mills of 10 tons per hour capacity were for installation under marine boilers totaling 2,550 horsepower.

Plan 275-Mile Natural Gas Line in Southwest

ARRANGEMENTS were completed Jan. 27 for the immediate construction of a 12-in., 900-lb.-pressure natural-gas pipe line and four compressor stations at a cost of $6,000,000 by the Western Gas Company, a subsidiary of El Paso Natural Gas Company.

The line will extend 275 miles westward from the present terminus at El Paso to Douglas and Bisbee, Ariz., and Cananea, Mex., to serve the Phelps-Dodge Corporation, the Calumet & Arizona Mining Company, the Cananea Consolidated Copper Company, the Arizona Edison Company and adjacent and intervening territory, according to an announcement by Paul Kayser, president of the El Paso Natural Gas Company.

The design and plans are being prepared by Ford, Bacon & Davis, and the construction will be supervised by Stone & Webster Engineering Corporation. The line is scheduled to be in operation by Aug. 1. The route of the line will be through Deming, N. M.

Engineers to Formulate Water Power Policy

THROUGH the initiative of the Hydraulic Division of the American Society of Mechanical Engineers, following presentation at its recent annual meeting of a paper by Frank E. Bonner, then executive secretary of the Federal Power Commission, the American Engineering Council has been requested to form a joint committee composed of representatives of the A.S.C.E., A.I.E.E., A.S.M.E. and A.E.C., which will be known as the "Engineers' Water Power Policy Committee." This proposal has received the approval of the governing bodies of the A.S.C.E., A.S.M.E. and A.I.E.E.

University of California Dedicates Kerckhoff Hall

KERCKHOFF HALL, the new University Union building presented to the University of California at Los Angeles as a memorial to the late William G. Kerckhoff, pioneer in hydro-electric development in California, was dedicated Jan. 20. The building and furnishings are the gift to the university of Mrs. Kerckhoff, who formally presented the memorial at the dedication ceremony. Gov. James Rolph, Jr., of California; Robert G. Sproul, president of the university; Ernest Carroll Moore, director of the university at Los Angeles; regents of the university, and officers of the Associated Students, participated in the ceremony.

Mr. Kerckhoff's name appears frequently in the record of the development of the light and power companies of southern and central California. With A. C. Balch, he pioneered in the generation and transmission of hydro-electric energy in the south, organizing the San Gabriel Electric Company in 1897. Together, they later formed the Pacific Light & Power Company and became associated with Henry E. Huntington, who then controlled the Los Angeles Railway, and took the first steps toward development of what now is the Big Creek-San Joaquin River hydro-electric generating system of the Southern California Edison Company, Ltd.

Mr. Kerckhoff died Feb. 22, 1929, at the age of 73 years.

N.E.L.A. Announces Ten Prize Awards for 1931

TEN PRIZE AWARDS which will be made to companies and individuals at the next convention of the National Electric Light Association to be held in Atlantic City, N. J., June, 1931, have just been announced by the Prize Awards Committee of the association. They comprise the National Employees' Speaking Contest prizes, Charles A. Coffin Foundation award for the most distinguished contribution by a company to the development of the light and power industry, Henry L. Doherty prize for the most meritorious paper, Martin J. Insull prize for the best paper dealing with public relations, H. M. Byllesby prizes for the best papers on utility accounting, James H. McGraw prizes for the best engineering papers, James E. Davidson prizes for the best papers on commercial or merchandising problems, James M. Gilchrist advertising award, Augustus D. Curtis award for the greatest contribution to electric lighting and the B. C. Forbes public service cup. Cash awards range from $100 to $1,000.

News of Canada

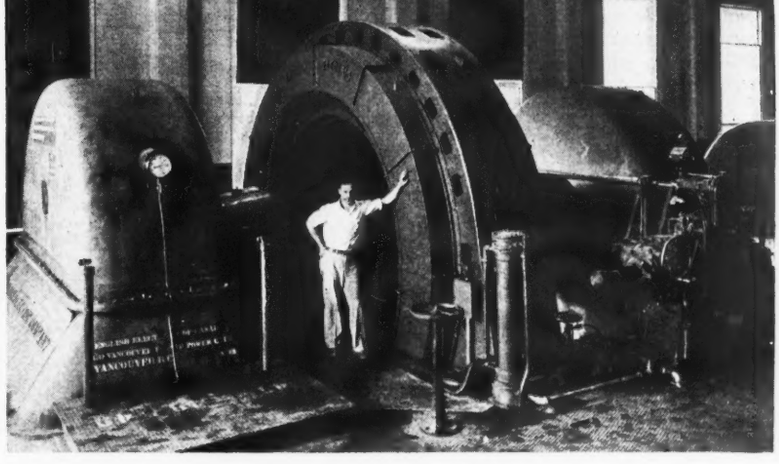
Grand Falls station completed—Manitoba commission buys Brandon plant—Electrical industry optimistic

THE FOURTH 20,000-HP. GENERATOR in the Grand Falls, New Brunswick, hydro-electric plant has been placed in commercial operation by International Hydro-Electric System. With the starting of this unit, the full installation of 80,000 hp. in the power house has been completed, and one of the greatest engineering undertakings in the province brought to a successful culmination.

As the Grand Falls station was originally built to house four generators and as the new unit completes the installation, no extension to the power-house structure was required. Both waterwheel and generator are duplicates of the others in operation in the plant, which ranks as the largest hydro-electric development in the Maritime Provinces. The plant is owned and operated by the St. John River Power Company, a subsidiary of International Hydro-Electric System.

FOLLOWING NEGOTIATIONS covering a period of nearly three months, the Canada Gas & Power Company, of Brandon, Manitoba, has sold its plant to the province for $1,200,000. The case had been taken before a court of arbitration but the price set by the court, $1,398,000 was deemed by the government to be too high. The way, however, was left open for further negotiations and these have now been successfully concluded.

The Manitoba Power Commission has taken possession of the plant and electrical energy from the provincial dis-



The fourth and final unit installed recently in the British Columbia Electric Company's Jordan River plant, completing that development and bringing its total capacity up to 39,500 hp., is a 15,000-kva., 6,600-volt, 60-cycle, 3-phase English Electric generator driven at 300 r.p.m. by two tangential waterwheels, one mounted on each end of the shaft and overhanging the bearings. The wheels are rated at 18,000 hp. and regulated by a single governor of the oil-pressure type

tribution system is being supplied over the new steel tower transmission line recently completed from Portage la Prairie. Officials of the provincial hydro system believe that the purchase of the Brandon plant will make certain the successful development of the provincial hydro in Western Manitoba.

IN A YEAR-END REVIEW of the electrical industry in Canada, D. C. Durland, president of the Canadian General Electric Company, Ltd., says: "The electrical industry experienced a recession in business during the year 1930, but maintained a fair level of activity considering the unfavorable general conditions, and looks forward with confidence to 1931. There is now under construction in Canada approximately 2,162,000 hp., involving an expenditure of about $200,000,000. It has been estimated that to provide means of using this power an additional $650 per horsepower, or about $1,300,000,000, must be expended on the construction of industrial and other establishments in which electrical equipment plays an important part. Consequently the electrical industry in the Dominion should enjoy an expanding field of activity, and the Canadian manufacturers are adequately equipped to supply all of the electrical machinery and appliances to fulfill the country's requirements."

Los Angeles Consolidates Power and Water Bureaus

CONSOLIDATION of the Los Angeles, Calif., municipal water and power bureaus as one department of water and power was effected recently by the board of water and power commissioners. H. A. Van Norman, formerly chief engineer and general manager of the bureau of water works and supply, was appointed chief engineer and general manager of the consolidated bureaus. E. F. Scattergood, formerly chief engineer and general manager of the separate bureau of power and light, was made chief electrical engineer of the newly organized department.

The water and power commissioners also ordered the dismissal of four employees of the power and light bureau on charges that they were guilty of the removal and destruction of public records during the water bonds campaign in May, 1930. The employees ordered dismissed are Burdett Moody, business agent of the bureau of power and light; C. O. West, executive assistant in the engineering department of the bureau; James F. Moran, a construction foreman, and T. H. Mullen, head of the bureau's transportation division.

This sweeping reorganization of the bureaus was made for the purpose of increasing efficiency and economy, according to the resolution adopted by the board.

A proposal that the Los Angeles, Calif., city council submit a $19,000,000 municipal power bond issue to voters at the general city election of June 2 was made to the council by Thomas W. Williams, councilman, on Jan. 15. The proposal was referred to the council's water and power and legislative committees and to the board of water and power commissioners for report.

COMING CONVENTIONS

American Society of Mechanical Engineers. National Fuels Meeting in Chicago, Ill., Feb. 10-13. Semi-annual meeting in Birmingham, Ala., Apr. 20-23. Meeting at Hartford, Conn., June 1-3. National Oil and Gas Power Meeting at the University of Wisconsin, Madison, Wis., June 15-18. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. District meeting in Pittsburgh, Pa., March 9-13. District meeting in Rochester, N. Y., May 6-10. Annual summer convention in Asheville, N. C., June 22-26. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Refrigerating Engineers. Spring meeting at the Hotel President, Kansas City, Mo., May 6-8. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Society for Testing Materials. Annual meeting at the Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Annual meeting in New York City, Apr. 22-24. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers. Annual meeting and exposition at the Cleveland Public Auditorium, Cleveland, Ohio, June 15-19. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

Engineering Institute of Canada. Annual meeting at the Windsor Hotel, Montreal, Que., Feb. 4-6. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National District Heating Association. Annual convention at the Hotel Statler, Boston, Mass., June 2-5. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 8-12. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

National Marine Engineers' Beneficial Association. Annual convention at the Lee House Hotel, Washington, D. C., Feb. 9-15. Secretary-treasurer, Albert L. Jones, 313 Machinists Building, Washington, D. C.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Universal Craftsmen Council of Engineers. Annual convention at the Stevens Hotel, Chicago, Ill., Aug. 4-8. Grand Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

Personals

A. E. BALLIN, who for the past fifteen years has been president of the McIntosh & Seymour Corporation, builders of diesel engines, which has lately been purchased by the American Locomotive Company, is retiring from that corporation and will be succeeded by ROBERT B. MCCOLL, who is now manager of the Schenectady works of the American Locomotive Company.

THOMAS S. PERKINS, formerly manager of supply engineering and consulting engineer of the Westinghouse Electric & Manufacturing Company, is now general manager of distribution engineering for the company. R. W. OWENS, manager of industrial motor engineering of the company, has been made general manager of industrial engineering; W. M. MCCONAHEY has been appointed consulting engineer with headquarters in the transformer engineering department of the Sharon Works; H. V. PUTNAM succeeds Mr. McConahey as manager of the transformer engineering department; M. S. HANCOCK is now assistant manager of the industrial motor engineering department; R. E. MARBURY is assistant manager of the supply engineering department, and ROBERT LEE WILSON has resigned as assistant to the president.

W. R. PENDER, power plant betterment engineer, has recently returned from foreign assignments in Central and South America and is now located at the William Penn Hotel in Houston, Texas.

J. A. LONGLEY, assistant to the general manager of the Tennessee Power Company, has been made vice-president of the company. Mr. Longley has been associated with the Tennessee utility for the past 17 years, starting in 1913 with construction work on the Nashville steam plant of the Nashville Railway & Light Company.

D. ROBERT YARNALL, vice-president and treasurer of the Yarnall-Waring Company, was elected a vice-president of the American Engineering Council at its recent annual meeting held in Washington, D. C.

F. B. DRAKE, of the Johnson Gear Company, and B. F. SHEPHERD, chief metallurgist of the Ingersoll-Rand Company, have been made national directors of the American Society for Steel Treating, to serve for a period of two years.

C. H. DONNELLY, formerly on the engineering staff of the United States Light & Power Company, Niagara Falls, N. Y., is now technical assistant to the general superintendent of the American Can Company at Simcoe, Ontario. From 1920 to 1926, Mr. Donnelly was with the construction department of the Ontario Hydro Electric Commission as assistant to the superintendent of the Queenston plant.

Business Notes

FAIRBANKS, MORSE & COMPANY, Chicago, Ill., announce the appointment of C. B. Murphy as manager of their stationary diesel engine sales, with headquarters in Chicago. Mr. Murphy joined the Fairbanks-Morse organization in 1911, according to the announcement, and since 1929 he has been located in Washington, D. C., as special representative of the company's diesel engine division.

CROLL-REYNOLDS ENGINEERING COMPANY, New York City, announces a substantial expansion of its sales and service facilities with the appointment of the following representatives: Starkweather & Broadhurst, Inc., Boston, Mass.; E. H. Bollenbacher, Atlanta, Ga.; Garrett-Burgess, Inc., Detroit, Mich., and the Smiley Equipment Company, Kansas City, Mo. It is also announced that the company's staff in the executive and engineering office at 17 John St., New York City, has been augmented with the appointment of D. H. Jackson, formerly of the Elliott Company, as sales manager.

ILLINOIS TESTING LABORATORIES, INC., Chicago, Ill., announces the appointment of the James H. Knapp Company, 4920 Loma Vista Ave., Los Angeles, Calif., with a branch in San Francisco, as the exclusive Pacific Coast distributor of its products.

KENNEDY VALVE MANUFACTURING COMPANY, Elmira, N. Y., announces the appointment of Harvey Embry as its representative in Detroit and the lower Michigan peninsula.

SARCO COMPANY, New York City, announces the opening of new Canadian headquarters as SARCO CANADA LTD., Federal Building, 85 Richmond St., West, Toronto, Ont. The Canadian company will operate under the direct supervision of E. E. Wells, vice-president, and H. T. Carter has been appointed general manager. It is also announced that arrangements have been made with Mueller, Ltd., Sarnia, Ont., to manufacture the company's products in Canada, and Peacock Bros., Ltd., 660 Catherine St., West, Montreal, and the Engineering Equipment Company, 1072 Beaver Hall Mill, Montreal, will handle the products of the company in Quebec and the maritime provinces. The Gordon Russell Company, 744 Hastings St., Vancouver, B. C., has been appointed sub-agent for British Columbia. Other sub-agencies are being negotiated, it is stated.

CHICAGO PUMP COMPANY, Chicago, Ill., announces the appointment of two new sales representatives. R. K. Rothrock, 2204 Jefferson Ave., New Orleans, La., will represent the company in the New Orleans territory, and J. M. MacCrea, 153 Oakland St., Syracuse, N. Y., will represent the company in the Syracuse territory.

How's Business?

IMPROVEMENT is painfully slow. This is disappointing to those looking for miracles, without understanding how they are produced; but in the longer view the absence this year of a swift rebound from the December bottom is encouraging in a left-handed way. Our index has dropped a little this week, but still moves on a level a few points above December. The rise in steel activity is slowing down; but merchandise carloadings suggest increasing movement of finished goods to depleted inventories; building contracts and power production continue to resist further decline; only money turnover, as reflected in bank debits and currency in circulation, has dropped a bit, and the latter has its favorable side, indicating greater public confidence in the banks. The deflationists are now dominant in every aspect of public and private policy. Under such conditions improvement depends solely upon increase of consumer replacement demand, and is bound to be slow.—*The Business Week*, Feb. 4.

Trade Catalogs

ENGINEERING SERVICE—The E. Y. Sayer Engineering Corporation, Broadway and 42nd St., New York City, have just issued an illustrated bulletin, No. 17, entitled "An Engineering Service That Supplements Your Own Engineering Department." This booklet describes in an interesting manner the work performed by the corporation in design, drafting, construction and the preparation of reports.

PACKING—An illustrated booklet recently issued by the Rains Metallic Packing Company, 433 Havermale Ave., Spokane, Wash., describes the specifications, applications and advantages of Rains metallic packing. It contains numerous illustrations of installations that have long been in service.

VARIABLE SPEED CONTROL—Reeves Pulley Company, Columbus, Ind., has just issued a new "Handbook of Variable-Speed Control." Intended as a textbook on the subject, this handbook contains a service manual and complete engineering data on all sizes of Reeves variable-speed transmissions.

PUMPS—Bulletin No. 126 of the Chicago Pump Company, 2336 Wolfram St., Chicago, Ill., illustrates and describes non-clogging pumps of the enclosed-shaft type. Single and duplex units are shown, with all improvements in design treated in detail. Blueprints of many different types of installations are included together with engineering specifications and tables of heads capacities and horsepowers.

STEAM SPECIALTIES—Catalog No. 12 covering steam specialties has just been issued by the Durabla Manufacturing Company, 114 Liberty St., New York City. An interesting feature of this publication is a section devoted to the discussion of gaskets for high pressures and temperatures, in which a new development pertaining to the use of highly compressed asbestos fibre gaskets is announced. Other products described in the catalog include packing, gage glass, valve disks and pump valves.

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Fuel Prices

FUEL OIL

New York—Jan. 29, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, contract, 6c. per gal.

St. Louis—Jan. 20, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.339 per bbl., or 42 gal.; 26@28 deg., $1.464 per bbl.; 28@30 deg., $1.589 per bbl.; 30@32 deg., $1.689 per bbl.; 32@36 deg., gas oil, 3.901c. per gal.; 38@40 deg., distillate, 4.526c. per gal.

Pittsburgh—Jan. 21, f.o.b. local refinery, 34@36 deg., fuel oil, 3.5c.@ 3.75c. per gal.; 36@40 deg., 3.37½c.@ 3.75c.

Philadelphia—Jan. 20, No. 4, light, $1.31 per bbl.; No. 5, medium, $1.22; No. 6, heavy (Bunker C) $1.10.

Cincinnati—Jan. 20, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—Jan. 16, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 60c. per bbl.; 22@26 deg., 67.5c. per bbl.; 26@30 deg., 80c. per bbl.; 30@32 deg., 95c. per bbl.; 32@36 deg., gas oil, 2.25c. per gal.

Boston—Jan. 26, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.9c. per gal.; 28@ 32 deg., 4.8c. per gal.

Dallas—Jan. 24, f.o.b. local refinery 24@26 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol..	New York...	$1.90 @$2.25
Pool 10, h. gr. low-vol.	New York...	1.75 @ 1.85
Pool 11, low-vol.....	New York...	1.60 @ 1.75
Smokeless, mine-run..	Chicago.....	1.75 @ 2.25
Smokeless, slack.....	Chicago.....	.75 @ 1.35
Harlan, Ky., slack....	Chicago.....	.60 @ .90
Franklin, Ill., mine-run	Chicago.....	2.15
Franklin, Ill., screen...	Chicago.....	1.35 @ 1.60
Ind. 5th Vein, m.-r....	Chicago.....	1.50 @ 1.85
Standard Ill., mine-run	St. Louis.....	1.50
W. Ky., mine-run	Louisville....	1.00 @ 1.35
W. Ky., slack.....	Louisville ...	.30 @ .40
Pittsburgh, mine-run.	Pittsburgh....	1.30 @ 1.60
Smokeless, mine-run..	Cincinnati...	1.75 @ 2.25
Smokeless, slack.....	Cincinnati...	.75 @ 1.35
Kanawha, mine-run..	Cincinnati...	1.10 @ 1.35
Kanawha, nut-slack.	Cincinnati...	.50 @ .75

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat.....	New York...	$3.50
Barley.....	New York...	1.50

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Los Angeles—City awarded contract for sewage treatment work including pump and boiler house, etc., to F. F. Greenfield Co., 1808 West 7th St. $106,070.

Calif., Los Angeles—Hillcrest Country Club is receiving bids for the construction of an automatic sewage pumping plant in connection with sewage system, etc. J. Singer, 112 North Main St., is engineer.

Calif., Oakland — J. Breuner Co., Clay St. (furniture dealers), is having plans prepared for an 8 story stores building at 21st St. and Broadway. Estimated cost $1,000,000. A. F. Roller, First National Bank Bldg., San Francisco, is architect. H. J. Brunnier, Sharon Bldg., San Francisco, is engineer.

Calif., Sacramento—Consumers Ice & Cold Storage Co., 9th and L Sts., awarded contract for the construction of a refrigerator car ice and cold storage plant at 9th and C Sts. to W. W. Williamson, 320 Market St., San Francisco, $150,000.

Calif., San Francisco—University of California, Berkeley, awarded contract for the construction of a power plant at Third and Parnassus Ave. here to J. S. Hannah, 268 Market St. $23,000. Contract for mechanical equipment let.

Calif., Santa Rosa—Pacific Gas & Electric Co., 245 Market St., San Francisco, is receiving bids for the construction of a group of service buildings including transformer house, meter house, shops, etc., here. Estimated cost $60,000.

Ill., Chicago — University of Chicago, 122 South Michigan Ave., awarded contract for a 9 story club and dormitory building at 9th St. and Blackstone Ave. to R. F. Wilson & Co., 1851 Elston Ave. $1,500,000.

Ill., Elsah — Christian Science College, St. Louis, Mo., is having plans prepared for the construction of a group of college buildings here. Estimated cost $2,000,000. Maybeck & White, 163 Sutter St., San Francisco are architects and Julia Morgan, Merchants Exchange Bldg., Los Angeles, is associate architect.

Ill., Kewanee—Western Illinois Ice Co., Galesburg, will build an ice plant here. Estimated cost $60,000. Westerlin & Campbell, 1113 Cornelia Ave., Chicago, are engineers. Work will be done by owners' forces.

Ill., Morton Grove—City plans waterworks improvements, including pumping station, auxiliary pumps, mains, etc. $80,000 bond election for same.

Ill., Peoria—Canadian Illinois Light Co., 316 South Jefferson St., plans to expend $275,000 during 1931 for extensions and improvements to electric division. Private plans.

Ind., Evansville—Evansville Ice & Storage Co., awarded contract for a 50x101 ft. refrigeration plant at Eighth and Court Sts., to Long & Smith, Evansville. Estimated cost $25,000.

Ind., Indianapolis — Indiana Bell Telephone Co., J. F. Carroll, Pres., 256 North Meridian St., will receive bids about May 1 for the construction of an 8 story telephone building at New York and Meridian Sts. Estimated cost $1,000,000. Vonnegut, Bohn & Mueller, 610 Indiana Trust Bldg., are architects.

Ind., Winchester—United Public Service Co., plans extensions and improvements to plant. Estimated cost $50,000. Private plans. Work will be done by owner's forces.

Ia., Bloomfield—City, W. J. Brown, Clk., will receive bids until Feb. 11 for a new sewage treatment plant, including two pumping stations, etc. Estimated cost $45,000. H. R. Green Co., 417 First Ave. S. E., Cedar Rapids, are engineers.

Kan., Kansas City—Bd. of Public Utilities, C. Lowder, Secy., will soon award contract for a 94 x 130 ft. power plant. Burns & McDonnell Engineering Co., 407 Interstate Bldg., Kansas City, Mo., are engineers.

Ky., Walton—City will soon award contract for waterworks improvements, including dam, 150 g.p.m. centrifugal pump, etc. Estimated cost $50,000. C. N. Harrub Engineering Co., 4th and First Bldg., Nashville, Tenn., are engineers.

Mass., Boston—Boston University, 688 Boylston St., is having preliminary sketches made for the construction of a group of college buildings at Commonwealth Ave. between Cottage Farm Bridge and Granby St. Estimated cost $5,000,000. Cram & Ferguson, 248 Boylston St. and Coolidge, Shepley, Bulfinch & Abbott, Ames Bldg., are architects.

Mass., East Springfield—United Electric Light Co., 73 State St., Springfield, will soon receive bids for the construction of an electric light plant, 66,000 to 115,000 v. Estimated cost $1,250,000. Private plans. Current taken from Turners Falls Power Corp.

Mass., Sandwich—Town plans a waterworks system including pumping station, etc. Estimated cost $15,000. Engineer not announced.

Mass., Yarmouth—Town is having plans prepared for a waterworks system including pumping station, etc. Estimated cost $75,000. Whitman & Howard, 89 Broad St., Boston, are engineers.

Mich., Detroit—Bd. of Education, 1354 Broadway, C. A. Gadd, Bus. Mgr., will soon award contract for a 2 story school including power house, boilers, coal handling equipment, etc., at Maine St. and Davison Ave. Estimated cost $160,000. Bonnah & Chaffee, 300 Merchants Bldg., are architects.

Mo., Caruthersville—City plans an election in March to vote $90,000 bonds for an electric light and power plant, equipment and distribution system. Russell & Axon, 6200 Easton Ave., St. Louis, are engineers.

Mo., St. Louis — Crystal Ice Co., Inc., L. Margolin, Secy. and Treas., Omaha, Neb., awarded contract for a 1 and 2 story, 60 x 120 ft. ice plant at Easton and Spring Aves., here, to A. H. Stiel, 813½ Chestnut St., St. Louis. Estimated cost $100,000 including equipment.

N. H., Concord—City is receiving bids for Soucook River pumping station. Estimated cost $15,000. Metcalf & Eddy, Statler Bldg., Boston, Mass., are engineers.

N. J., East Rutherford — Bd. of Council, Municipal Bldg., plans the construction of a waterworks system, including reservoir, pump house, etc. Estimated cost $25,000. Engineer not announced.

N. J., Preakness—Bd. of Chosen Freeholders, Court House, Paterson, will receive bids about Feb. 15 for the construction of a welfare house and detention home, including laundry and power plant equipment, etc., at Oldham Rd. Estimated cost $500,000. F. W. Wentworth, 140 Market St., Paterson, is architect.

N. Y., New York—Chanin Bros., 122 East 42nd St., will build an apartment building at Central Park W. and 62nd St. Estimated cost $8,000,000. Work will be done by separate contracts. Contracts let for excavation and steel erection.

N. Y., Schenectady—General Electric Co., B. L. DeLack, Mgr., River Rd., plans the construction of a steam power plant, 26,700 hp. capacity. Estimated cost $4,000,000. Work will be done by day labor. Plant will be leased and operated by New York Power & Light Co., subsidiary of Niagara Hudson Power Co., 15 Broad St., New York.

N. C., Oteen—U. S. Veterans Bureau, Washington, D. C., plans the construction of a group of buildings including hospital, power house, laundry, etc., at U. S. Veterans Hospital here. Estimated cost $625,000.

Okla., Fairfax—City plans an election Feb. 24 to vote $120,000 bonds for the construction of a municipal electric light and power plant. V. V. Long & Co., Colcord Bldg., Oklahoma City, are engineers.

Tex., Brownsville—City will soon award contract for improvements to existing boilers by adding a superheater and new mechanical equipment in connection with municipal light plant. L. D. Royer, Smith Young Tower, San Antonio, is engineer.

Tex., Port Arthur — City is having preliminary surveys made for moving 50,000 g.p.m. pump and engine unit from Central plant to Lakeview station, also to install a new 110,000 g.p.m. pump and engine unit at Central station in connection with waterworks. W. O. Bower is city engineer.

Wis., Stevens Point — Consolidated Water Power & Paper Co. of Wisconsin Rapids, is having plans prepared for the construction of a pumping station here.

Ont., Hamilton — Hydro Electric System of Hamilton, 12 King St. E., plans extensions and improvements to light and power system during 1931, including construction of new substation in south west part of city, ties between new sub-station and Dundas St. sub-station, etc. Estimated total cost $395,000. E. I. Sifton, 12 King S. E., is engineer.

Ont., Toronto—Spadina Gardens Ltd., c/o A. J. Everett and J. D. Wilson, 2 Leader Lane, Archts., plans the construction of a sports arena, including artificial ice plant, etc., on Spadina Ave. Estimated cost $1,500,000.

Que., Montreal—Canadian National Railways, awarded contract for the construction of a 3 story, 76 x 638 ft. fruit warehouse including unloading platform, etc., to Atlas Construction Co., 37 Belmont St.

Equipment Wanted

Pumping Unit—Wichita Falls, Tex.—City plans to purchase pumping unit, etc., for proposed waterworks improvements. Estimated cost $1,000,000.

Pumping Units—Neadesha, Kan.—City, S. G. Hamilton, Clk., will receive bids until Feb. 7 for two 1,000,000 g.p.m. pumping units, etc., in connection waterworks improvements. Black & Veatch, 701 Mutual Bldg., Kansas City, Mo., are engineers.

Pumps—Ottawa, Ont.—Bd. of Control, will receive bids about Mar. 1 for new pumps for Queen Street pumping station. $56,000.

Pumps, Etc.—Hamilton, Ont.—City will receive bids until Mar. 5 for four low lift waterworks pumps and two wash water pumps, etc., for proposed waterworks.

Sub-Station Equipment, Transformers, Etc.—Erie, Pa.—Erie County Electric Co., 12th and French Sts., P. S. Sturtevant, plans to purchase equipment for proposed addition to sub-station at Peach and Cherry Sts., also transformers and other equipment for power line to new municipal water and pumping station now under construction.

Transformers and Switchgear—Wellington, N. Z.—Dept. of Public Works, will receive bids until Apr. 14 for 43,333 kva. transformers including Bucholz relay spares, also until May 5 for 66 and 33 kv. outdoor switchgear and steelwork.

Industrial Projects

Ariz., Lowell—Lucy Bell Mining Co., c/o F. Jones, Mgr., plans mine improvements including 25 ton ball mill compressor light plant and additional company houses.

Calif., Pomona—City Dairy Co., awarded contract for a 1 and 2 story creamery and dairy plant including refrigeration plant, etc., at 6th and Garey Sts., to H. Poulsen, 645 North Towne Ave. Estimated cost $45,000.

Ga., Austell—Clark Thread Co., J. B. Clark, Pres., 260 Ogden St., Newark, N. J., will receive bids until Feb. 10 for the construction of a thread mill (first unit), 3 story, 498 x 133 ft. to house 40,000 spindles, 2 story, 50 x 100 ft. warehouse, 50 x 100 ft. opener room building and 1 story boiler room here. Initial cost $2,000,000. Ultimate total cost $12,000,000. J. G. Sirrine & Co., Greenville, S. C., are architects and engineers.

Mo., St. Louis—Chandeysson Electric Co., 4092 Bingham Ave., will build an 82x200 ft. addition to electric manufacturing plant at 4092 Bingham Ave. Estimated cost $40,100. Clymonts & Heinicke, 721 Wainwright Bldg., are architects.

N. J., Elizabeth—Service Machine Co., 158 Miler St., awarded contract for a 2 story, 50 x 60 ft. addition to factory to Wilhelm Construction Co., 119 Division St. Estimated cost $40,000.

N. J., Newark—M. N. Shoemaker, 10 Bleecker St., Archt., will receive bids about Feb. 15 for a 2 story addition to factory at 361-65 6th Ave., for Weldron Roberts Rubber Co., 180 Oliver St. Estimtaed cost $40,000.

Okla., Oklahoma City—Anderson-Pritchard Oil Corp., Colcord Bldg., is having preliminary plans prepared for the construction of a casinghead gasoline plant. Estimated cost $60,000. Private plans.

Pa., Knox—Monaca Glass Co., F. B. Hess, Treas., plans the construction of a plant for the production of glass bottles and kindred products. Estimated cost $50,000.

Pa., Philadelphia—Philadelphia Storage Battery Co., E. Davis, Ontario and C Sts., awarded contract for a 5 story, 94x250 ft. factory at C and Tioga Sts., to Wm. Steele & Sons Co., 124 North 15th St.

Tex., Fort Worth—Texas Rail Joint Co., Joliet, Mo., awarded contract for the construction of a 1 story steel fabricating plant including machine shop and forging plant at Commerce St. N. E. and 4th St. here to Quisle & Andrews, 2212 West 7th St., Fort Worth. Estimated cost $150,000.

Wash., Seattle—A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt., is receiving revised bids for a 1 and 2 story, 320x750 ft. automobile assembly plant including assembly building, oil house, dock 40 ft. wide and 500 ft. long on East Marginal Way, for Ford Motor Co., Dearborn, Mich. Estimated cost $1,500,000. Elevators and conveying equipment, etc., will be required.

Ont., Ojibway — Canadian Steel Corp., subsidiary of United States Steel Corp., 30 Church St., New York, N. Y., plans additions to steel plant here. Estimated cost approximately $60,000,000. **Maturity indefinite.**